ACCELERATED CLOTTING TIME A NEW PREDICTOR OF GESTATIONAL AGE

PANDEY KIRAN • BHAGOLIWAL AJAY • SINGH V. K.

SUMMARY

Various parameters have been studied to estimate the prenatal gestational age. The aim of this study is to evaluate ACT, which is a simple bedside test, as a reliable predictor of gestational age by quantifying the relationship between ACT and gestational age. We studied 106 patients with known last menstrual periods. Least Squares estimation of linear models was used to select the best fitting statistical model to describe the relationship between ACT and gestational age. An R^2 value of 0.82 & 0.83 were found for the two models we have developed. Our results suggest that ACT can be used with a great degree of precision to predict gestational age, specially in the third trimester of pregnancy. With fetal characteristic like BPD as predictor of gestational age, the predicted 95% confidence interval is ± 2 to ± 3 weeks wide, limiting its use in clinical decision making. ACT gives a more exact estimate of gestational age with a 95% confidence interval as wide approximately one week only.

INTRODUCTION

The accurate prenatal assessment of the gestational age is of prime importance specially in the management of high risk pregnancies. With the advent of ultrasound, many parameters have been studied in an attempt to assess gestational age. However no parameter could be identified which can reliably predict gestational age specially in the last trimester. Foetal biparcital diameter, the most commonly used parameter also lacks the precision in the last 10 weeks of gestation. (Sabhagha et al, 1974). Same is true with Femur length (FL) Abdominal Circumference (AC).

Philips and Davidson (1972) studied the procoagulant properties of amniotic fluid and established the thromboplastic activity of amniotic fluid (TAAF) which increased with advancing pregnancy. Hastwell (1974) has

Dept. of Obst. & Gyn. G. S. G. M. Medical College, Kanpur.

Accepted for Publication on 20.10.1993.

shown that amniotic fluid accelerates the rate of clotting time of whole blood and termed this reduced clotting time as accelerated clotting time (ACT) (Hastwell, 1978). He developed a simple beside test based on TAAF for assessing fetal maturity.

Yaffe et al (1977) observed that the rate of TAAF in pregnancies associated with pathologies like toxaemia, diabetes mellitus and Rh incompatibility do not differ from those of normal pregnancies unlike other gestational age predictors which might be unduly influenced by these pathologies.

In the present study we have made an attempt to quantify the relationship between TAAF and gestational age in order to establish ACT as a predictor of gestational age and develop a calibration curve along with 95% confidence bands.

MATERIALS AND METHODS

One hundred and six patients were evaluated. The Study population was between 28 to 42 weeks gestation. Only those cases were included whose date of last menstrual period were known. Accelerated clotting time was calculated by the method proposed by Hastwell (1978).

Amniotic fluid samples were obtained either by transabdominal aminocentesis under ultrasound guidance or transuterine amniocentesis at the time of cesarian section of transvaginally before artificial rupture of membranes and in active phase of labour. Blood stained and meconium stained amniotic fluid was discarded from the study. 1.5 ml. blood was drawn from the ante cubital vein of the patients and added to 1 ml. of amniotic fluid in a clear dry test tube at 37°C. The test tube was tilted every 5 seconds and clotting time was measured in seconds.

Regression analysis was performed and least Squares estimation of linear models was used to select the best mathematical model to describe the relationship between gestational age and ACT. (William, 1959). At each week of gestation 95% confidence limits were calculated. Statistical calculations were performed using the MINITAB package at Indian Institute of Technology, Kanpur Computer Centre.

RESULTS

The distribution of gestational age and ACT for the sample consisted of cases from 28 to 42 weeks of gestation. Residual analysis for each model revealed no tendencies toward nonlinearity and no statistically significant difference could be achieved using polynomial regression. We, therefore, concluded that a straight line is the most suitable calibration curve describing the relationship

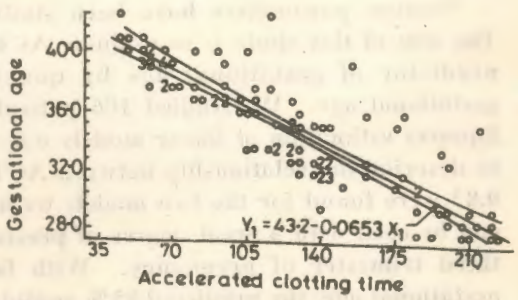

Fig. 1 : Scattergram of gestation age vs ACT & line of best fit alongwith 95% confidence bands.

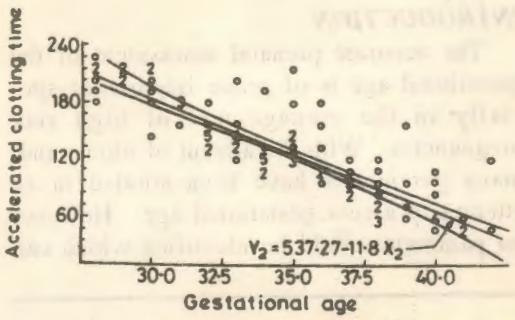

Fig. 2 : Scattergram of ACT vs gestational age & line of best fit along with 95% confidence bands.

between gestation age and ACT. Fig. 1 represents the scattergram of gestational age versus ACT along with the line of best fit and 95% confidence bands for various values of ACT.

Figure 2 represents the scattergram of ACT versus gestational age along with the line of best fit and 95% confidence bands for various values of gestational age.

Table I

Mathematical models describing the relationship between gestational age and accelerated clotting time (ACT)

Dependent Variable	Intercept	Slope	Independent Variable	R^2	Sample Mean
ACT	537.27	-11.8	Gestational Age	0.82	122.7
Gestational Age	43.2	-0.0653	ACT	0.83	35.09

Table II

Predicted mean values of ACT alongwith 95% confidence limits for various gestational ages

Gestational Age (in weeks)	ACT (in seconds)	St. Dev. of fit	95% confidence interval	
28	207.92	5.08	(197.84,	218.0)
29	196.16	4.53	(187.16,	205.15)
30	184.40	4.01	(176.44,	192.35)
31	172.63	3.52	(165.65,	179.62)
32	160.87	3.09	(154.74,	167.00)
33	149.11	2.73	(143.69,	154.53)
34	137.35	2.49	(132.41,	142.28)
35	125.58	2.39	(120.84,	130.33)
36	113.82	2.46	(108.94,	118.70)
37	102.06	2.68	(96.74,	107.38)
38	90.30	3.02	(84.30,	96.29)
39	78.53	3.45	(71.70,	85.37)
40	66.77	3.93	(58.99,	74.56)
41	55.01	4.44	(46.19,	63.82)
42	43.25	4.99	(33.35,	53.14)

Table III

Predicted maximum 95% confidence interval of gestational age at various values of ACT

ACT (in sec.)	No. of cases	Max. St. Dev. of FIT	Max. width of 95% confidence interval
225 - 175	24	0.396	± 2 x 0.396 = ± 0.792 weeks
160 - 130	25	0.218	± 2 x 0.218 = ± 0.436 weeks
125 - 45	57	0.332	± 2 x 0.332 = ± 0.664 weeks

A linear regression model derived from sample is $Y_1 = 43.2 - 0.0653\ X_1$ where X_1 = ACT and Y_1 = gestational age. The other linear regression model with gestational age as the independent variable is $Y_2 = 537.27 - 11.8\ X_2$ where X_2 = gestational age and Y_2 = ACT. Table I presents the statistical models describing the relationship between gestational age and ACT and their respective R(Sq) values. Table II give the fitted values of ACT alongwith 95% confidence interval for various gestational ages between 28-42 weeks. Table III shows the maximum width of 95% confidence interval for various values of ACT.

DISCUSSION

Steiner & Lushbaugh (1941) and Ratnoff & Vosburgh al (1952) detected that embolism due to amniotic fluid accelerates blood clotting. It was Hastwell (1974 and 1978) who first developed a bed side test for determining foetal maturity based on TAAF. Yaffe et al (1977) concluded that mean value of ACT decreases as pregnancy advance. In our study we have attempted to quantify this relationship between ACT & gestational age. To this purpose, regression analysis was used for determining the line of best fit instead of correlation analysis as attempted by Yaffe et al (1977) since the two variables are not interdependent. Here ACT depends on gestational age but the viceversa is not true. Hence any model based upon the correlation coefficient will not accurately describe the relationship between the two variables. The nomogram suggested by us establishes ACT as a relaible predictor of gestational age. Sabbagha et al (1974) has pointed out that the accuracy of gestational age estimation based on ultrasonic measurement of B.P.D. decreased markedly in later gestational ages. The interval of confident being ± 2 to ± 3 weeks. This limits its use using ACT as a predictor of gestational age the maximum width of confidence interval is ± 0:79 weeks which accounts for a little over one week. Hence in later gestational ages ACT has a distinct edge over B.P.D., FL etc. in predicting gestational age.

REFERENCES

1. *Hastwell GB. Aust. NZ. J. Obstet. Gynec. 14 : 196, 1974.*
2. *Hastwell GB. AM. J. Obstet. Gynec. 131 : 650, 1978.*
3. *Phillips LL, Davison EC. AM. J. Obstet. Gynec. 1 13 : 911, 1972.*
4. *Ratnoff OD, Vosburgh GJ. N. Engl. J. Med. 247 : 970, 1952.*
5. *Sabbagha RF, Turner HJ, Rockette H., Obstet, Gynec. 43 :7, 1974.*
6. *Steiner PE, Lushbaugh CC. J. Am. Med. Assoc. 117, 1245, 1941.*
7. *Williams EJ. Regression Analysis 1st ed 95, 1959. John Wiley & Sons, New York.*
8. *Yaffe H, Eldor A, Hornshtein E, Sadovosky E. J. Obstet. Gynec. 50 : 454, 1977*