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Determination Of Gestational Age In Third Trimester Using Foetal Transcerebellar Diameter And Assessment Of Foetal Growth Using Tcd/Ac Ratio

Jayaprakash N[1], *Arun Kumar S[2], Sangeetha Devi P.S[3]
[1]*Assistant professor, Department of Radiology, PSG Institute of medical science and research, Coimbatore, India.*
[2]*Associate Professor, Department of Radiology, Karpagam Faculty of Medical Science and research, Coimbatore, India*
[3]*Assistant Professor, Department of Paediatrics, Karpagam Faculty of Medical Science and research, Coimbatore, India*
*Corresponding Author:*Arun Kumar S.*

Abstract:
Objectives:*To evaluate the role of fetal transcerebellar diameter (TCD) as an independent parameter in predicting the gestational age in the third trimester of pregnancy. To derive nomogram from sonographically measured foetal transcerebellar diameter for estimating the gestational age in Indian population.*
Materials and methods:*Hospital based prostective study.148 healthy pregnant patient in third trimester were included in the study who underwent obstetric sonography using GE Voluson P8 machine. In all the patients following parameters were obtained - BPD, HC, AC, FL, TCD, foetal heart rate, estimated foetal weight, AFI and placental position. Transverse cerebellar diameter is obtained in the axial plane in the cerebellar view. Gestational age for the measured TCD is obtained from the reference chart by Hill et.al.,TCD/AC ratio was calculated according to the following formula: TCD/AC ratio (%): TCD (mm)/AC (mm) x 100*
Conclusion:*TCD correlates with clinical gestational age as the first best parameter and also positively correlates with BPD, HC, AC and FL. So TCD can be reliably be used for gestational age assessment in third trimester. TCD/AC ratio remains fairly constant in third trimester with value of 14.59 +/- 2SD, So the ratio is independent of gestational age and can be used in assessing the fetal growth in pregnancies with unknown dating.*

Keywords: *Foetal growth, Gestational age,TCD/AC ratio, Third trimester, Transcerebellar diameter.*

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I. Introduction

Ultrasound assessment of gestational age is becoming increasingly important[1]. Obstetric surveillance and management of complicated pregnancy and decisions regarding the optimal timing of delivery remains paramount important. Estimation of gestational age using ultrasonographically derived fetal parameters is perhaps the cornerstone in obstetrics and is an important component in the management of pregnancies [2].

Many parameters are being used for establishing gestational age, for example biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) (1). Identification of aberrant growth as well as growth disturbance across the spectrum of GA in both healthy fetuses and those with genetic abnormalities will be helpful for optimal fetal surveillance [2]. Evaluation of the posterior fossa of the fetal cranium has been accepted as part of routine obstetric ultrasound examination. Parameters such as BPD, HC and AC compute the gestational age more correctly in the earlier gestation.

Fetal transcerebellar diameter can predict the gestational age reliably at any trimester since cerebellum is not liable to change in its form and also its size. The fetal cerebellum grows progressively along with gestational age[1]. The cerebellum and posterior fossa are aligned perpendicular to the plane of maximum extrinsic compression and withstand deformation by extrinsic pressure than the parietal bones [3]. So fetal transcerebellar diameter has remained consistently superior in predicting GA in second and third trimester, both singleton and twin gestations and in variation of fetal head shape such as dolicocephaly and brachycephaly and in normal fetus and in intrauterine growth restricted fetus (IUGR). Fetal transcerebellar diameter to abdominal circumference ratio is used to determine the correct gestational age and also to predict intrauterine growth restriction (IUGR) [1,2].

II. Objectives

(i) To evaluate the role of fetal transcerebellar diameter as an independent parameter in predicting the gestational age in the third trimester of pregnancy.
(ii) To derive nomogram from sonographically measured foetal transcerebellar diameter for estimating the gestational age in Indian population.

III. Inclusion and Exclusion Criteria

3.1 Inclusion criteria:

Healthy women with uncomplicated pregnancy between the 25^{th} week of gestation and term.

3.2 Exclusion criteria:

Unknown or inaccurate date of last menstrual period (LMP), irregular menstrual cycles, oligohydramnios.

Polyhydramnios, diabetic mother, pregnancy induced hypertension, pre eclampsia, dolichocephalic and brachycephalic skull, multiple gestation fetal chromosomal abnormalities, fetal anomalies intrauterine growth restriction and any other known maternal and foetal abnormality.

IV. Materials and Methods

4.1 Hardware

GE Voluson P8.

4.2 Methods

Hospital based prostective study. Ethical clearance was obtained from the institutional ethical review committee of Karpagam faculty of medical science research, Coimbatore. All the statutory requirements under PC-PNDT act were followed. All relevant clinical history was obtained and the correct LMP was confirmed.

148 healthy pregnant patient included in the study who underwent obstetric sonography in Department of Radiology, and Karpagam faculty of medical science research, Coimbatore. In all the patients following parameters were obtained - BPD, HC, AC, FL, TCD, foetal heart rate, estimated foetal weight, AFI and placental position.

Transverse cerebellar diameter is obtained in the axial plane in the cerebellar view i.e with a slight rotation of the transducer approximately 30^0 from the conventional thalamic plane where the biparietal diameter is measured using the cavum septi pellucidi, third ventricle and thalami as landmarks. In this plane posterior fossa with cerebellum is visualized. The cisterna magna is just posterior to the cerebellum. This plane provides the widest transcerebellar diameter.

Gestational age for the measured TCD is obtained from the reference chart "Predicted menstrual age for transverse cerebellar diameter of 14 mm to 56 mm"by Hill *et.al*., in his study "Transverse cerebellar diameter as a predictor of menstrual age" in 1990. TCD/AC ratio was calculated according to the following formula: TCD/AC ratio (%): TCD (mm)/AC (mm) x 100

Figure 1: The caliper on the edge of the cerebellar hemisphere demonstrates the method to obtain transcerebellar diameter.

4.3 Statistical analysis

The following methods of statistical analysis have been used in this study.

The results for each parameter (numbers and percentages) for discrete data and averaged (mean + standard deviation) for continuous data are presented in Table and Figure.

4.3.1 An evaluation was made of the linear relationship between two variables using Pearson's correlation. Pearson Correlation technique used to test the direction and strength of the relationship between gestational age obtained using transverse cerebellar diameter vs individual parameters such as biparietal diameter, head circumference, abdominal circumference and femoral length. It uses the statistic R which falls between -1 and +1. The + and – signs are used for positive linear correlations and negative linear correlations, respectively.A correlation greater than 0.8 is generally described as strong, whereas a correlation less than 0.5 are generally described as weak.

The coefficient of determination, r^2, is useful because it gives the proportion of the variance (fluctuation) of one variable that is predictable from the other variable. It is a measure that allows us to determine how certain one can be in making predictions from a certain model/graph.

4.3.2 The student't' test was used to determine whether there was a statistical difference between the parameters measured. Student's t test is as follows:

. $t=\dfrac{\bar{x}_1-\bar{x}_2}{s\sqrt{\dfrac{1}{n_1}+\dfrac{1}{n_2}}}$ ~~~ $t_{n1+n2-2}$ Where $s^2=\dfrac{(n_1-1){s_1}^2+(n_2-1){s_2}^2}{(n_1+n_2-2)}$

In the above test the "p" value of less than 0.05 was accepted as indicating statistical significance. Data analysis was carried out using Statistical Package for Social Science (SPSS, V 10.5)

V. Results

The age of 148 patient included in the study was in the range of 17 to 36 years with the mean age of 26.6 years.

5.1 Third trimester correlation

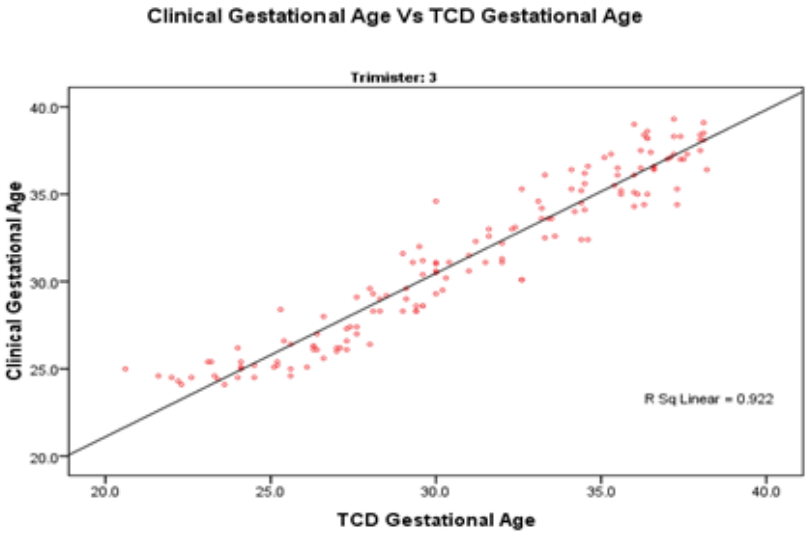

Figure 2. A scatter diagram showing the correlation and regression analysis of the TCD with CGA in third trimester. Here TCD is correlated with CGA by 92.2 %.

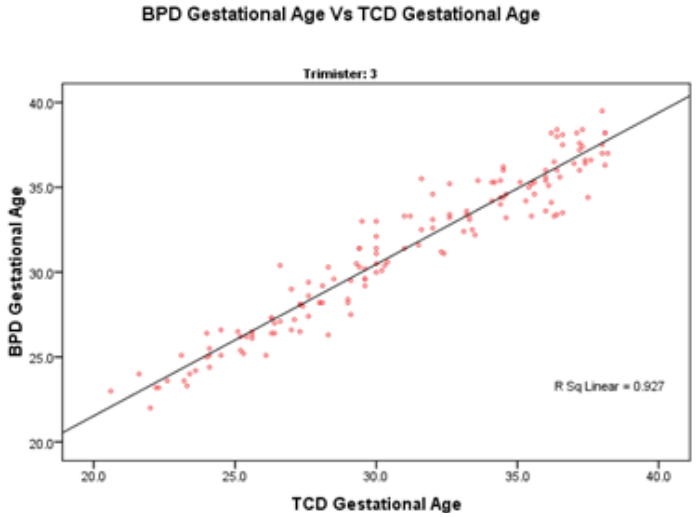

Figure 3. A scatter diagram showing the correlation and regression analysis of the TCD with BPD in third trimester. Here TCD is correlated with BPD by 92.7 %.

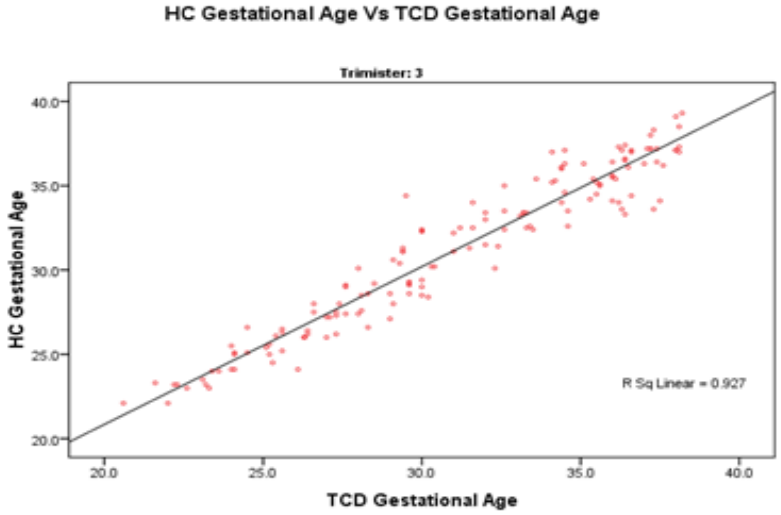

Figure 4. A scatter diagram showing the correlation and regression analysis of the TCD with HC in third trimester. Here TCD is correlated with HC by 92.7 %.

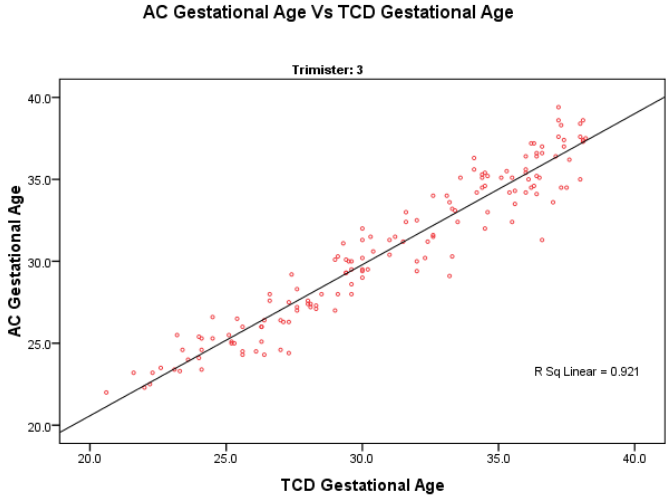

Figure 5. A scatter diagram showing the correlation and regression analysis of the TCD with AC in third trimester. Here TCD is correlated with AC by 92.1 %.

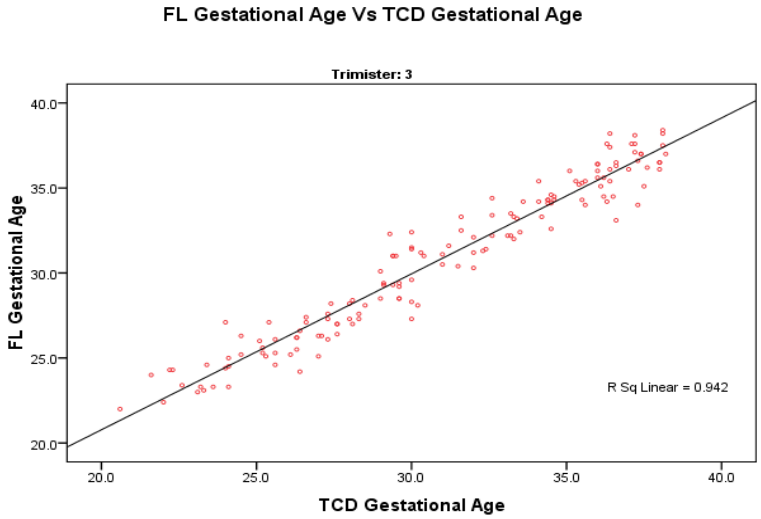

Figure 6. A scatter diagram showing the correlation and regression analysis of the TCD with FL in third trimester. Here TCD is correlated with FL by 94.2 %.

TCD is correlated with Clinical GA, BPD, HC, AC and FL in third trimester by 92.2%, 92.7%, 92.7%, 92.1% and 94.2% respectively.

TABLE 1. Correlation co-efficient of TCD with CGA, BPD, HC, AC and FL in third trimester

Combination Of Parameters	***Pearson's Correlation Co-Efficient (r)***	***Significance***
TCD VS CGA	0.960	P<0.001
TCD VS BPD	0.963	P<0.001
TCD VS HC	0.963	P<0.001
TCD VS AC	0.960	P<0.001
TCD VS FL	0.970	P<0.001

This table reveals the association between the foetal measurements and TCD. The correlation was best for TCD vs FL (r : 0.970). The correlation for TCD vs CGA, BPD, HC and AC was almost similar (r : 0.960, 0.963, 0.963 and 0.970 respectively). All the correlations were statistically significant.

TABLE 2. Correlation co-efficient of CGA with BPD, HC, AC, FL and TCD in third trimesters

Combination of Parameters	***Pearson's Correlation Co-Efficient (r)***	***Significance***
CGA VS BPD	0.937	P<0.001
CGA VS HC	0.947	P<0.001
CGA VS AC	0.952	P<0.001
CGA VS FL	0.960	P<0.001
CGA VS TCD	0.960	P<0.001

The above table shows the association between foetal measurements with CGA. The correlation was best for CGA vs FL and CGA vs TCD (r : 0.960). All the correlations were statistically significant.

5.2 TCD/AC Ratio:

TCD/AC remain fairly constant, between 25th week and term with values of TCD/AC ratio 14.59 +/- 2SD (SD: 1.14). There was a strong linear relationship between TCD and AC.

Table 3. Nomogram

TCD (mm)	***Gestational age***	***TCD (mm)***	***Gestational age***
29	25.3	43	33.4
30	25.7	44	34.1
31	26.5	45	34.4
32	27.2	46	34.7
33	27.8	47	34.9

34	28.6	48	35.7
35	29.2	49	36.1
36	29.7	50	36.4
37	30.3	51	36.8
38	31.0	52	37.2
39	31.4	53	37.4
40	31.9	54	37.8
41	32.5	55	38.0
42	33.2	56	38.1

VI. Discussion

In this study of 148 healthy women with uncomplicated pregnancy shows correlation between the gestational age and TCD. This has also been proven by various other studies. There is a linear relationship between the cerebellar growth and the gestational age in the third (24 wks to term) trimester. This relationship of foetal cerebellar growth and gestational age is statistically significant. In the present study the correlation of TCD with other foetal biometric parameters such as BPD, HC, AC and FL were statistically significant with the P value of 0.963, 0.963, 0.960 and 0.970 respectively. TCD correlate with the clinical gestational age with the statistically significant P value of 0.960. So in the present study TCD correlates well with gestational age with high correlation coefficient of 0.96 in the third trimester along with FL, as the first accurate parameters for assessing the gestational age.

The fetal cerebellum visualized as early as 10-20 postmenstrual weeks, grows in linear pattern in second trimester but its curve flattens in third trimester [1]. The normal foetal TCD increase with advancing gestational age and exhibit a more than two fold increase in size during the second half of pregnancy [4]. Normal sonographic anatomy of the developing cerebellum can be misinterpreted for pathological conditions [5,6]. So caution is warranted in making an early diagnosis of foetal cerebellar dysgenesis [5].

Sonographic transverse cerebellar diameter is not affected by the alteration in the shape of the foetal skull which affects the biparietal diameter and increase the variability [7-9]. TCD correlates well with gestational age and is more useful indicator of the accurate gestational age in case of dolichocephaly or brachycephaly and facilitate antenatal detection of congenital disorders [8]. Difference in actual gestational age and gestational age predicted by TCD is 0-4 days for 17-21 weeks, 0-2 days for 22-28 weeks, > 5 days for 29-36 weeks and 9 days for 37 weeks [10]. Foetal TCD correlates well with the clinical gestational age in third trimester also [1,10].

The foetal TCD / AC ratio is a gestational age independent method of assessing foetal growth [1,11-13]. In normal pregnant women the TCD / AC ratio was fairly constant with the mean of 13.68 +/- 0.96 irrespective of gestational age [1,12,13]. A value exceeding 2 SD of the mean was significantly associated with birth of a small for gestational age infants but not useful for identifying large for gestational age infant [12]. In the present study we found that TCD/AC ratio remains fairly constant in third trimester with value of 14.59 +/- 2SD (SD: 1.141). There was a strong linear relationship between TCD and AC. TCD/AC ratio was 13.6 +/- 0.95% in study done by Campbell *et. al.* in 1991 [13]. Meyer and his colleagues described that TCD/AC ratio is 13.69+/-0.94% in there study in 1993 [12]. According to studies by Malik *et. al*. in 2003 [14] and 2006 [1] TCD/AC ratios were 0.14064 +/-0.059 and 0.13 respectively.

The foetal TCD is not independent of the ethnic origin of the patient [15,16]. A study in 2001 on 153 normal pregnant women on Thai population concludes that growth rate of TCD was slightly less than that of a western study after 28 weeks of gestation [16]. In our study, all the patients were of Indian origin and the normogram for predicting gestational age from TCD was obtained. The values were compared with a study conducted by Hill *et. Al* [17]and it was observed that the values reported in our study are slightly smaller. This is probably due to the difference in the ethnic origin of patients.

The foetal TCD is useful for prediction of gestational age at the extremes of foetal growth [18-20]. There is relative preservation of normal cerebellar growth in growth restricted fetuses and a similar rate of growth in singleton and multifoetal gestation. In most of growth restricted fetuses, except for TCD all other biometric parameters will be < 10^{th} percentile [18]. The difference between actual and predicted gestational age based on TCD in IUGR foetus is within 3 days in 97.5% in the second trimester and 93.3% in the third trimester. In large for date foetus the difference between actual and predicted gestational age based on TCD is within 3 days was 100% in both second and third trimesters [19].

VII. Conclusion

TCD correlates gestational age as the first best parameter and also positively correlates with BPD, HC, AC and FL.So TCD can be reliably be used for gestational age assessment in third trim. TCD/AC ratio is independent of gestational age and can be used in assessing the fetal growth in pregnancies with unknown

dating. The results of present study show that transcerebellar diameter along with other parameters can improve the accuracy of antenatal sonography as well as sensitivity and specificity for fetal growth abnormalities.

References

[1]. Ghazala Malik, Fareesa Waqar, Abdul Ghaffar and Huma Zaidi, Determination of gestational age by transverse cerebellar diameter in third trimester of pregnancy, JCPSP, 2006, 16(4), 249-252.
[2]. Martin R. Chavez et. al., Fetal transcerebellar diameter measurement for prediction of gestsational age at the extremes of fetal growth, J Ultrasound Med,2007, 26, 1167-1171.
[3]. Mahony, B. S., Callen, P. and Filly, A. R., The distal femoral epiphysisal ossification center in the assessment of third trimester menstrual age: sonographic identification and measurement, Radiology,1985, 155, 201-204.
[4]. Vinkesteijn, A. S. M., Mulder, P. G. H. and Wladimiroff, J. W., Fetal transverse cerebellar diameter measurements in normal and reduced fetal growth, Ultrasound in obstetrics and gynecology, 2000, 15(1) 47-51.
[5]. Catherine J. Babcook et. al., Sonograhic anatomy of the developing cerebellum: normal embryology canresemble pathology, AJR, 1996, 166, 427-433.
[6]. Brayann Bromley et. al., Closure of the cerebellar vermis: evaluation with second trimester US, Radiology, 1994, 193, 761-763.
[7]. Mikovic Z. et. al., Growth of the fetal cerebellum in normal pregnancy, Jugosl Ginekol Perinatol, 1989, 29, 5-6, 157-160.
[8]. Hata, K. et. al., Ultrasonographic measurement of the fetal transverse cerebellum in utero, Gynecol obstet invest, 1989, 28(2), 111-112.
[9]. Goldstein, I., Reece, E. A., Pilu, G., Bovicelli, L. and Hobbins, J. C., Cerebellar measurements with ultrasonography in the evaluation of fetal growth and development, Am J Obstet gynecol, 1987, 156(5) 1065-1069.
[10]. Chavez et. al., Fetal transcerebellar diameter measurement with particular emphasis in the third trimester: a reliable perictor of gestational age, Am J Obstet gynecol, 1995, 191(3) 979-984.
[11]. Meyer, W. J. et. al., The fetal transverse cerebellar diameter / abdominal circumference ratio: a gestational age – independent method of assessing fetal size, J Ultrasound Med, 1993, 12(7) 379-382.
[12]. Meyer et. al., Ultrasonographic detection of abnormal fetal growth with the gestational age independent transverse cerebellar diameter / abdominal circumference ratio, Am J Obstet gynecol, 1994, 171(4) 1057-1063.
[13]. Winston A. Campbell et. al., Transverse cerebellar diameter / abdominal circumference ratio throughout pregnancy: a gestational age – independent method to assess fetal growth, Am J Obstet gynecol, 1991, 77(6) 893-895.
[14]. Malik, R., Pandya, V. K. and Shrivastava, P., Gestational age estimation using transcerebellar diameter with grading of fetal cerebellum and evaluation of TCD/AC ratio as a gestational age independent parameter, Ind J Radiol Imag, 2003, 13(1) 95-97.
[15]. Jacquemyn, Y., Sys, SU and Verdonk, P., Fetal transverse cerebellar diameter in different ethnic groups, J Perinat Med, 2000, 28(1) 14-19.
[16]. Uerpairojkit, B. et. al., Fetal transverse cerebellar diameter in Thai population groups, J Med Assoc Thai, 2001, 84(1) S346-351.
[17]. Hill, L. M., Guzick D. and Fries J., Transverse cerebellar diameter as a predictor of menstrual age, Obstet Gynecol, 1990, 75, 983.
[18]. Goldstein et. al., Cerebellar growth in normal and growth restricted fetuses of multiple gestation, Am J Obstet gynecol, 1995, 173(4) 1343-1348.
[19]. Martin R. Chavez et. al., Fetal transcerebellar diameter measurement for prediction of gestsational age at the extremes of fetal growth, J Ultrasound Med, 2007, 26, 1167-1171.
[20]. Guan B., Surveillance of fetal growth and fetal cerebellar transverse diameter by ultrasonographic measurement, Zhonghua Yi Xue Za Zhi, 1992, 72(2) 65-67.

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