The amniotic fluid index in normal twin pregnancies

Lyndon M. Hill, MD,[a, b] Marijane Krohn, PhD,[b] Noam Lazebnik, MD,[c] Brenda Tush, RDMS,[a] Deborah Boyles, RDMS,[a] and John J. Ursiny, MBA, RRA[b]

Pittsburgh, Pennsylvania, and Detroit, Michigan

OBJECTIVE: We sought to investigate the amniotic fluid index for individual gestational sacs of twin pregnancies.

STUDY DESIGN: Four hundred eighty-eight patients with normal diamniotic twins were examined between 14 and 40 weeks' gestation. The dividing membrane between twin fetuses was identified. An amniotic fluid index was then obtained for each gestational sac.

RESULTS: The median amniotic fluid index in individual twin gestational sacs rises slowly from 14 to 16 weeks' gestation to 23 to 28 weeks' gestation and then gradually declines. The median amniotic fluid index values by gestational age for twin A and twin B are not statistically different. Although twin pregnancies have a slightly lower median amniotic fluid index value than singleton pregnancies, the difference is also not statistically significant.

CONCLUSION: Individual amniotic fluid indices can be obtained in twin pregnancies, and the values are comparable with those of singleton gestations. (Am J Obstet Gynecol 2000;182:950-4.)

Key words: Amniotic fluid index, twins

The frequency of pleural births in the United States is generally reported as around 2%.[1] Between 1973 and 1990, twin births have increased at twice the rate of singletons.[2] Women with multiple gestations are at increased risk for a number of complications that relate to the twinning process, placentation, and vascular exchange.[3] For example, Manlan and Scott[4] reported that twins account for >12% of infants with early neonatal death and 17% of infants affected by intrauterine growth restriction.

Amniotic fluid volume reflects both maternal and fetal status. Abnormalities of amniotic fluid volume, either too much or too little, are associated with an increase in maternal and fetal complications.[5, 6] The assessment of amniotic fluid volume has therefore become an important part of obstetric ultrasonographic examinations.

The amount of amniotic fluid in singleton pregnancies has been assessed with ultrasonography both subjectively[7] and semiquantitatively.[5, 6] In 1987, Phelan et al[8] described the amniotic fluid index (AFI), in which a vertical pocket of amniotic fluid free of umbilical cord in each quadrant of the uterus was summated. The AFI (mean ± SD) for singleton pregnancies is 16.2 ± 5.3 cm.[8]

The evaluation of amniotic fluid volume in twins is difficult. Subjectively, one could assess the amount of amniotic fluid around each fetus or attempt to visualize a satisfactory quantity of fluid on either side of the dividing membrane. Several groups have measured amniotic fluid volume in twins. A single vertical pocket in each gestational sac,[9] a 2-diameter pocket in each gestational sac,[9] and a 4-quadrant AFI of the entire uterus without the dividing membrane[10, 11] taken into account have all been reported. Although an evaluation of a single vertical pocket of amniotic fluid in each gestational sac addresses the potential differences that may occur in amniotic fluid volume between twins, the AFI has become a more commonly accepted technique for the evaluation of amniotic fluid volume in singletons.[8] We therefore sought to determine the normal range of the AFI in individual gestational sacs of normal diamniotic twins by gestational age.

Material and methods

Four hundred eighty-eight patients with diamniotic twin pregnancies were evaluated from August 23, 1991, to September 17, 1997. The gestational ages of the study population at the time of the ultrasonographic examination ranged between 14 and 40 weeks. Twin pairs in

From the Division of Ultrasound,[a] Department of Obstetrics, Gynecology and Reproductive Sciences,[b] Magee-Womens Hospital, Pittsburgh, and the Department of Obstetrics and Gynecology,[c] Henry Ford Hospital, Detroit.

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Reprint requests: Lyndon M. Hill, MD, Magee-Womens Hospital, Ultrasound Division, 300 Halket St, Pittsburgh, PA 15213.

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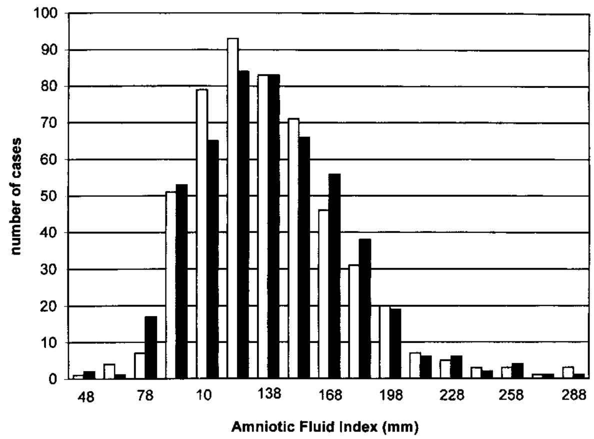

Fig 1. Histogram of AFI levels for twin A and twin B during 488 normal pregnancies. Twin A *(open columns):* mean, 136; SD, 32.5. Twin B *(filled columns):* mean, 137; SD, 33.3.

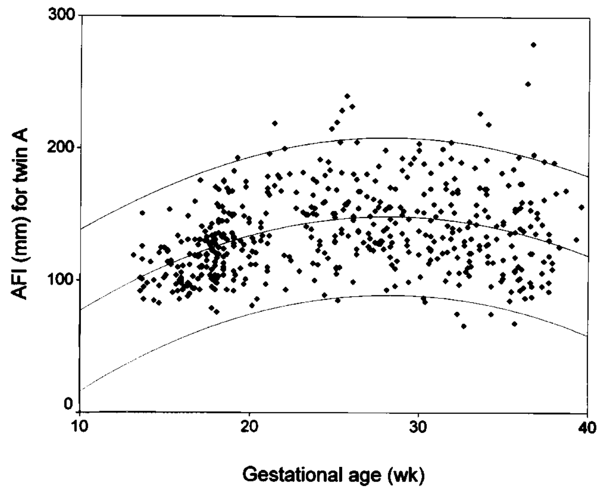

Fig 2. AFI levels for twin A during normal twin pregnancies. Systemic AFI levels were determined in 488 cases and plotted as a function of gestational age. Each *data point* represents a single determination. *Center line,* Quadratic regression line; *outer lines,* 95% confidence levels for data ($R^2 \leq 0.953$). Equation is as follows: $y = b_0 + b_1t + b_2t^2$, where b_0 is constant, t is gestational age, and y is AFI.

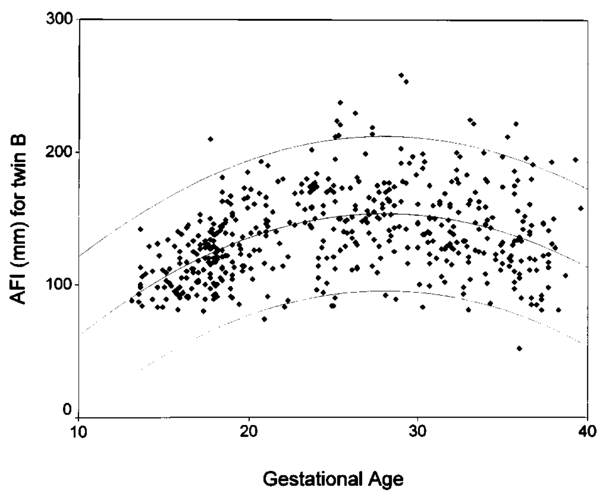

Fig 3. Amniotic fluid index levels for twin B during normal twin pregnancies. Systemic AFI levels were determined in 488 cases and plotted as a function of gestational age. Each *data point* represents a single determination. *Center line,* Quadratic regression line; *outer lines,* 95% confidence levels for data ($R^2 = 0.955$).

which one twin had a structural abnormality detected on antenatal ultrasonography were excluded. In addition, cases of documented twin-to-twin transfusion syndrome that were confirmed by means of pathologic inspection of the placenta were excluded from the study group. Only those twin pregnancies in which the neonates weighed between the 10th and 90th percentile at delivery[12] were included. Each patient was evaluated once during this cross-sectional study.

Each ultrasonographic examination was performed with commercially available real-time equipment and either a 3.5- or 5.0-MHz curvilinear transducer (RT 3200 Advantage, Logiq 700; General Electric, Milwaukee, Wis). Standard fetal biometry was obtained, and the location of the placenta or placentas was noted. A comprehensive anatomic survey was completed on each fetus. To obtain the AFI for each gestational sac, the position of each fetus within its amniotic cavity was identified. The location of the membrane was followed ultrasonographically between the fetuses to the extent possible. Each amniotic sac was then divided into quadrants that might extend along a vertical, horizontal, or oblique axis on the basis of the relative position of the amniotic sac within the uterus. The deepest vertical pocket of amniotic fluid free of umbilical cord in each quadrant was measured, and the subsequent values were summated to obtain AFI in millimeters. Twin A was defined as the presenting twin at the time of the ultrasonographic examination.

To assess intraobserver and interobserver variation in the measurement of the AFI, measurements were repeated by the same observer in 46 cases, and two observers obtained measurements from the same fetus in 44 cases, respectively. These cases were selected early in the study to determine the feasibility of obtaining twin AFI values. In 2 cases a second examiner was not readily available to obtain AFI measurements. Intraclass correlation coefficients were estimated from these data. The 2.5th to 97.5th percentile values for twin A and twin B were determined by ranking the AFI values for each twin separately. The 5th, 50th, and 95th percentiles[13] were used for comparing twin A with twin B and for comparison with published AFI values from singletons. The AFI data of Moore and Cayle[14] on normal singleton pregnancies were used for purposes of comparison because they also excluded

Table I. Amniotic fluid index percentile values for twin A in normal twin pregnancies

	Percentile							
Gestation (wk)	*2.5th*	*5th*	*10th*	*50th*	*90th*	*95th*	*97.5th*	*No.*
14-16	83.2	85.2	87.5	103.0	128.1	148.5	153.8	42
17-19	85.1	92.4	94.7	124.0	158.6	170.7	176.0	106
20-22	81.9	89.9	99.8	134.0	183.9	198.6	215.7	46
23-25	89.7	95.5	110.5	150.0	182.6	191.3	211.0	46
26-28	91.3	104.4	110.0	149.0	205.0	229.3	236.4	57
29-31	85.1	91.5	101.0	139.0	189.0	194.5	202.1	54
32-34	70.5	97.0	106.0	140.0	190.0	200.0	216.0	59
35-37	71.5	85.0	92.0	132.0	185.0	219.0	265.0	59
38-40	92.0	92.0	96.0	131.0	190.0	191.0	191.0	19
TOTAL	85.2	92.0	97.0	131.0	180.0	193.0	205.0	488

All measurements are in millimeters.

Table II. Amniotic fluid index percentile values for twin B in normal twin pregnancies

	Percentile							
Gestation (wk)	*2.5th*	*5th*	*10th*	*50th*	*90th*	*95th*	*97.5th*	*No.*
14-16	81.2	83.0	84.0	100.5	133.1	139.7	141.0	42
17-19	89.0	90.4	92.0	120.0	150.6	163.0	173.6	106
20-22	75.2	87.1	108.2	139.5	178.6	188.3	192.5	46
23-25	83.2	84.0	92.2	152.0	177.9	182.6	198.9	46
26-28	98.6	110.8	112.8	151.0	215.0	224.6	234.4	57
29-31	85.3	91.3	108.0	150.0	195.0	215.8	257.1	54
32-34	87.0	98.0	106.0	144.0	187.0	200.0	223.5	59
35-37	68.5	85.0	90.0	133.0	186.0	197.0	217.0	59
38-40	81.0	81.0	81.0	123.0	193.0	195.0	195.0	19
TOTAL	84.0	89.0	93.9	133.0	180.0	196.6	212.8	488

All measurements are in millimeters.

anomalous fetuses and fetuses with a birth weight <10th percentile and >90th percentile. Histograms of AFI values were plotted for twin A and twin B (Fig 1). The mean AFI values were compared between twin A and twin B by the paired *t* test and by comparison of the 95% confidence intervals for the means. A scatterplot of AFI values by gestational age is displayed in Figs 2 and 3. A quadratic curve was used to display the mean over various gestational ages along with 95% confidence intervals and R^2 values. A cubic curve was evaluated but provided no improved fit over a quadratic curve.

Results

The intraobserver and interobserver variations in the ascertainment of twin AFI values were 7.4% and 12.2%, respectively. Intraclass correlations for intraobserver and interobserver data were 0.88 and 0.79, respectively.

The 2.5th to 97.5th percentile values for twin A and twin B show that the AFI values for twins are similar. The median values for both twins rose between 14 and 28 weeks' gestation and then declined. The 95% confidence intervals were almost completely overlapping for twin A compared with twin B (Tables I and II). The mean AFI for twin A was 136 (95% confidence interval, 133-139), and the mean AFI for twin B was 137.0 (95% confidence interval, 134-140). The histograms for twin A and twin B show similar minimum values, maximum values, and shapes (Fig 1). A paired *t* test of AFI measurements for twins A and B showed no difference between the values ($P = .45$).

AFI values for twins A and B were plotted versus gestational age (Figs 2 and 3). The curves display the mean AFI with 95% confidence intervals as gestational age progressed. The quadratic shape of the curve ($P < .001$ for the quadratic term) confirms that the AFI index was highest at 26 to 28 weeks' gestation and declined as the gestation progressed to term. The R^2 value from a quadratic curve was similar for twins A and B: R^2 for twin A, 0.953; R^2 for twin B, 0.955. The cubic term added to the regression model did not appreciably increase the value of the R^2.

Comment

Abnormalities of amniotic fluid volume have been associated with adverse perinatal outcome.[5, 6] The single deepest vertical pocket[6] and the AFI[14] are the semiquantitative techniques most commonly used to evaluate amniotic fluid volume. When compared with the dye-dilution technique, both measurements are poor predictors of oligohydramnios.[15] Additional ultrasonographic techniques, which may include three-dimensional ultrasonography,[16] may, in the future, provide a more accurate assessment of amniotic fluid volume.

This prospective evaluation of the AFI in normal twin pregnancies from 14 to 40 weeks' gestation demonstrates that the individual assessment of twin amniotic fluid volumes is both possible and reproducible. Moore and Cayle[14] have reported intraobserver and interobserver variations of 3.0% and 7.0% in the assessment of singleton AFI values. In this study of twin gestations, our intraobserver and interobserver variations were 7.4% and 12.2%, respectively. Because the dividing membrane must be visualized to obtain individual twin AFI values, it is not surprising that the intraobserver and interobserver variations were slightly greater than those found for singletons.

Amniotic fluid volume has been measured in singleton pregnancies by means of direct collection at hysterotomy or in continuing pregnancies by means of dye-dilution techniques. The mean amniotic fluid volume does not change significantly between 22 and 39 weeks' gestation, averaging 777 mL with a 95% confidence interval of 302 mL to 1997 mL.[17] Magann et al[18] used a dye-dilution technique to evaluate amniotic fluid volume in 45 normal diamniotic twin pregnancies between 27 and 38 weeks' gestation. The mean amniotic fluid volume per amniotic sac ranged from 155 mL to 5430 mL with a mean ± 1 SD of 877 ± 860 mL. Hence the amniotic fluid volume in twins was similar to or slightly greater than the reported volume in singleton pregnancies. In contrast to our finding of a decline in twin AFI after 28 weeks' gestation, Magann et al[18] reported that the amniotic fluid volume in individual twin gestational sacs remained constant after 27 weeks' gestation. However, the number of cases studied at any given gestational age was limited. Additional dye-dilution studies with a greater number of patients at each gestational age will be required to better elucidate the amniotic fluid volumes in the third trimester of twin pregnancies.

In 1995, Watson et al[10] evaluated amniotic fluid volume in 210 normal twin pregnancies. The single largest pocket of amniotic fluid in each sac, as well as the AFI for the entire uterus without regard to the dividing membrane, was obtained. They reported a larger uterine AFI for twins compared with singletons. Chau et al[9] also performed a single AFI for 91 normal twin gestations and found that the AFI changed significantly with gestational age. However, this method of amniotic fluid volume assessment did not consider differences in fluid volumes between the twins. The twin-to-twin transfusion syndrome[19] is the most dramatic example of an abnormal twin pregnancy that might have a normally summated single AFI for both twins. As one would expect, Magann et al[20] have found that a summated AFI without regard to location of the dividing membrane is a poor predictor of intratwin differences in amniotic fluid volume.

A comparison of singleton AFI values[14] with the AFI values obtained for twin A and twin B indicates that the confidence intervals overlap. Hence there is no statistical evidence that the median values are different. In this study twins had a slightly lower AFI than singletons. A sample size calculation revealed that with 615 subjects in each group, a singleton AFI of 138 mm for 36 weeks' gestation would be statistically different from a twin AFI of 130 mm. We would therefore suggest that singleton and twin AFI be assessed by individualized normative data for singleton and twin pregnancies, respectively. For purposes of consistency, we would use the data obtained for twin A to evaluate the amniotic fluid volume in twins.

In conclusion, individual AFI values can be obtained in twin pregnancies and are very similar for twin A and twin B. Although the AFI values for twins are different from those found in previously published accounts of singleton pregnancies,[14] the confidence intervals overlap. Although dye-dilution measurement of twin amniotic fluid volumes indicates that the amount of fluid in individual gestational sacs is comparable with that found in singletons, the AFI values we obtained were somewhat lower than singleton AFI values. Subsequent dye-dilution studies will be required to determine whether the individual twin AFI values have the same relationship to actual amniotic fluid volume as the AFI values in singleton pregnancies.

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