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The Impact of Antenatal Testing for Advanced Maternal Age on Cesarean Delivery Rate at an Urban Institution

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Abstract

Objective—Antenatal testing has been implemented for advanced maternal age (AMA) women given their increased stillbirth risk. Our objective was to evaluate cesarean delivery and induction rates after the start of antenatal testing at our institution.

Study Design—A retrospective cohort study of AMA women (> 40 years) who delivered at our institution was performed. Testing for AMA began in 2005. AMA women who delivered before (unexposed) and after (exposed) the implementation were compared. Our primary outcome was cesarean delivery and secondary outcome was induction. Chi-square compared categorical variables and multivariable logistic regression calculated odds ratio (OR) and controlled for confounders.

Results—A total of 276 women were included (147 unexposed and 129 exposed). The cesarean rate was higher in the exposed group (53 vs. 39%, OR 1.76 [1.09–2.84]). The increased risk of cesarean remained after adjusting for race, previous cesarean, multiple gestations, and parity (adjusted OR 1.85 [1.05–3.28]). When excluding those with previous cesareans, the risk of primary cesarean was not significant (OR 1.57 [0.89–2.76]). The induction rate was not different (38 vs. 33%, $p = 0.4$).

Conclusions—While overall cesareans increased, there was no difference in primary cesarean and induction rates for AMA women after implementation of antenatal testing for AMA.

Keywords

advanced maternal age; antenatal testing; cesarean; induction

The birth rate for women over the age of 40 continues to increase with a rate of 11 births per 1,000 women in 2011.¹ Advanced maternal age (AMA) has been associated with an

increased risk of stillbirth²⁻⁵ even after controlling for risk factors such as hypertension, diabetes, and multiple gestation.^{2,3} While Fretts et al found an increase in the stillbirth rate among women older than 35 years of age, this rate was significantly higher in women over the age of 40.³ A 2.4-fold increased rate of stillbirth among women 40 years old or greater was noted when compared with women less than 40 years old.³ While the risk of stillbirth increases after 38 weeks for all age groups, Reddy et al noted that it was most remarkable in women over the age of 40, with a hazard of death of 2.5 per 1,000 for ongoing pregnancies in this age category.²

Given the known association of AMA and stillbirth, with a greater risk noted after the age of 40, antenatal testing guidelines have been implemented at many institutions based on maternal age greater than 40 years old. It is plausible that antenatal testing may lead to a higher rate of medical intervention including a higher rate of induction of labor and cesarean delivery. While a higher induction and cesarean delivery rate may be acceptable when the intervention is thought to prevent stillbirths, it is important to understand the implications that antenatal testing has in the AMA population to better counsel our patients.

The objective of this study was to evaluate the rate of cesarean delivery and induction of labor among women of AMA who had antenatal testing for AMA compared with those who delivered before the implementation of antenatal testing for AMA. Our hypothesis was that women who undergo antenatal testing for AMA have higher cesarean delivery and induction rates.

Study Design

A retrospective cohort study was performed with approval from the institutional review board at the University of Pennsylvania. While an increased stillbirth risk is noted even after the age of 35, the most appreciable risk is noted after the age of 40. In January 2005, our institution implemented twice weekly antenatal fetal surveillance beginning at 32 weeks for all women who are 40 years old or greater at their estimated delivery date. This consisted of twice weekly nonstress tests and twice weekly amniotic fluid assessment. For the remainder of the study, AMA will refer to women who were 40 years of age at their estimate delivery date.

Women were identified through our computerized perinatal database, which includes delivery information and age of all patients delivering at our institution. Women who were AMA who delivered from July 2003 to December 2004, the 18 months immediately before the antenatal testing changes, were chosen as the unexposed group. Women who were AMA and delivered from July 2005 to December 2006 were chosen as the exposed group. Women who delivered from January 2005 through June 2005, the 6 months after the implementation of the new guidelines, were excluded to allow for incorporation of the new guidelines into clinical practice. Total 18 months for the exposed and unexposed groups were chosen to achieve the targeted sample size. No other changes were made to our antenatal testing guidelines during this time period. Women were included if they received prenatal care, antenatal testing, and delivered at our institution. Women were excluded from the study if they had a planned cesarean delivery.

Our primary outcome was cesarean delivery rate. Our secondary outcome was induction of labor. Data collection was through chart abstraction from the maternal and neonatal electronic medical records. Variables collected included maternal demographics, obstetrical history, medical history, and labor and delivery information. All data were abstracted by a single reviewer (S.S.M.).

The overall cesarean delivery rate among AMA women in 2004 was estimated to be approximately 30%. Using a type 1 error of 5%, a power of 80%, and a two-sided test, we calculated that we would need 139 patients in each arm to detect a 1.5-fold increase in the cesarean delivery rate.

Data analysis occurred in two stages. The first part of the analysis compared demographic data between the two groups. Mann-Whitney U tests were used to compare non-parametric data, *t*-tests were used to compare parametric data, and chi-square tests were used to compare categorical variables. The second part of the analysis used bivariate comparisons to assess for potential confounders or risk factors for the outcome. Based on analysis with our dependent variable, cesarean delivery, we included risk factors in our multivariable model that had an association at a significance level of $p < 0.2$. These included race, previous cesarean, smoking, chronic hypertension, other indications for antenatal testing, gestational age at delivery, multiple gestation, and birth weight. We also included biologically plausible confounders including parity. We then created our multivariable model and used a backward stepwise elimination strategy to obtain a parsimonious model. The confounders included in the final model were race, previous cesarean, multiple gestation, and parity. While the Mantel-Haenszel estimate did not show previous cesarean to be an effect modifier, we separately analyzed women without a previous cesarean delivery to better assess the primary cesarean rate among AMA women.

All data were analyzed using Stata version 12.0 (StataCorp LP, College Station, TX). Statistical significance of $p < 0.05$ was used.

Results

There were 276 women who met inclusion criteria for the study—147 women in the unexposed group and 129 women in the exposed group. Table 1 shows the baseline characteristics between our two groups. Overall, the maternal demographics as well as the gestational age of delivery and birth weight were similar between the two groups. While not statistically significant, women in the exposed group were more likely to have another indication for antenatal testing other than AMA (45%) as compared with those in the unexposed group (33%).

When evaluating our primary outcome, cesarean delivery rate, we found a higher rate of cesarean in the exposed group as noted in Table 2. This risk remained significant after adjusting for confounders including maternal race, previous cesarean delivery, multiple gestation, and parity (adjusted odds ratio [aOR] 1.85 [1.04–3.28], $p = 0.035$). When limiting the analysis to women without a previous cesarean delivery ($n = 217$) and therefore

evaluating the primary cesarean delivery rate, the risk of primary cesarean delivery in the exposed group was not significant (OR 1.57 [0.89–2.76], $p = 0.1$).

The rate of induction of labor was not statistically different between the unexposed and exposed, 33 versus 38%, $p = 0.4$. When excluding women with a previous cesarean, there remained no statistically significant difference in the rate of induction (39 vs. 48%, $p = 0.2$).

There were three stillbirths within the cohort. There was no difference in the number of stillbirths between the unexposed and exposed groups (1 vs. 2, $p = 0.49$).

We then focused the analysis on women who had non-AMA indications for antenatal testing. When comparing those in the exposed group with non-AMA indications for antenatal testing ($n = 57$) to those in the unexposed group with non-AMA indications ($n = 49$), there was no difference in the cesarean rate (45 vs. 51%, $p = 0.5$) or the induction rate (49 vs. 46%, $p = 0.7$).

Next, to assess the outcomes among AMA women testing for AMA alone compared with testing for non-AMA indications, we focused on the group who were undergoing antenatal testing after the change in guidelines (the exposed group). We compared those who were having antenatal testing for AMA alone to those who were having antenatal testing for AMA plus another indication. We found no difference in the rate of cesarean delivery between the groups (55 vs. 51%, $p = 0.6$) and no difference in the induction rate (32 vs. 46%, $p = 0.1$).

Conclusion

Our study found an increased risk of cesarean delivery among AMA women who underwent antenatal testing for AMA compared with AMA women who delivered before the start of the antenatal testing for AMA. This increased risk of cesarean did not remain when excluding those with a previous cesarean and evaluating the primary cesarean rate. In addition, there was no significant difference in the rates of induction of labor between the exposed and unexposed groups.

Fretts et al performed a decision analysis evaluating the risks and benefits of antenatal testing in women with AMA and found a reduction in the stillbirth rate with a higher induction rate.⁶ Fox et al evaluated antepartum testing in AMA women compared with non-AMA women and found a similar rate of stillbirth with a higher induction rate; however, they did not specifically evaluate cesarean delivery rate and they used maternal age ≥ 35 for AMA.⁷ More recent literature also supports the increased obstetric interventions and utilization of care among AMA women; however, they did not evaluate the impact of antenatal testing on these interventions.⁸

Our study evaluated the rate of obstetric interventions, specifically cesarean delivery and induction of labor, after the initiation of antenatal testing for AMA. Our study supports previous literature showing an increased rate of cesarean delivery after the implementation of antenatal testing. Contrary to these previous studies, we did not find a difference in the rate of primary cesarean delivery or induction of labor in our study. This may be explained by the following. In our cohort of women in the unexposed group, the overall cesarean rate

was 39% and the induction rate was 33%. These rates are higher than our institution's cesarean delivery rate of 25% and induction rate of 23% during that time period. The reason for the higher cesarean and induction rates in AMA women even before the implementation of antenatal testing for AMA is likely due to the increased rate of underlying comorbidities among women who are AMA, including chronic hypertension and diabetes. If these medical comorbidities were reasons for these women to be undergoing antenatal testing before the implementation of our new guidelines for AMA, it is plausible that the underlying comorbidities, and not the AMA, are driving the cesarean delivery and induction rate and biasing our study to the null. In addition, while the primary cesarean rate is important, we were not powered to specifically evaluate this difference.

It is important to also compare the cesarean delivery and induction rates during the study time periods to more contemporary data since the number of AMA women who are delivering continues to increase¹ as do the number of women having cesareans.⁹ The overall cesarean delivery rate for 2012 at our institution was 28% and the induction rate was 22%. Among AMA women who delivered in 2012, the induction of labor rate was 30% and the overall cesarean delivery rate was 43%. When excluding women with a previous cesarean, the primary cesarean delivery rate was 37%, which is similar to the primary cesarean delivery rate in the exposed group in our study (40%). These data support the fact that AMA women remain at a high risk for cesarean delivery and induction of labor and that the primary cesarean rate continues to be elevated in AMA women today.

Our study has several strengths. This study was done at a large urban academic institution that is a referral center for a high risk population and highlights the elevated baseline risk of cesarean delivery and induction of labor in AMA women. We minimized the effects of various secular trends in antenatal testing and patient care by choosing a time period immediately preceding and immediately following the new guidelines. We also allowed for acclimatization by practitioners to the new guidelines by allowing a wash out period of 6 months before assessing the impact of these guidelines.

Our study was not without limitations. Our study represents a high risk urban population and may not be comparable to other communities with lesser comorbidities among their AMA women. The high presence of other indications for antenatal testing as well as the comorbidities in our population may limit generalizability to nonurban sites; however, these women are at an increased risk of cesarean and induction of labor and therefore this is an important population to evaluate. As a retrospective study, not all data were available through chart abstraction. In addition, the date of delivery is documented alongside other variables being obtained during data abstraction and therefore the abstractor was not blinded to the exposure. However, our outcomes of delivery mode and induction of labor are not subjective and the nonblinded nature of this study should therefore not introduce significant bias. While no other changes were made to the antenatal testing guidelines at our institution during this time, we cannot exclude the possibility that other factors in the 6 months between the two time periods resulted in changes in practice. Furthermore, our study was not powered to look at the primary cesarean rate or rate of induction and therefore, the nonsignificant difference may be due to being underpowered. Lastly, the primary aim of this

study was not to evaluate the rate of stillbirth and thus cannot comment on the ability of antenatal testing to alter the rate of stillbirth in women who are AMA.

With the maternal age at delivery continuing to rise, our results are reassuring and encouraging. While the overall cesarean rate was increased, there does not appear to be a difference in the primary cesarean delivery rate and induction of labor rate after implementation of antenatal testing for AMA at our institution. A prospective evaluation of AMA women with no other indication for testing compared with AMA women with other indications for testing may help further clarify and quantify the actual cesarean delivery and induction risks attributed specifically to AMA.

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Table 1

Baseline demographic information

	AMA women before antenatal testing change “unexposed” (<i>n</i> = 147)	AMA women after antenatal testing change “exposed” (<i>n</i> = 129)	<i>p</i> -Value
Maternal age (years) ^a	41.6 [40.7–42.8]	41.6 [40.8–43.0]	0.6
Race			
African American	57 (39)	62 (48)	0.1
Caucasian	59 (40)	37 (29)	
Other	31 (21)	30 (23)	
Previous cesarean delivery	27 (18)	32 (25)	0.2
Parity			
Nulliparous	33 (22)	27 (21)	0.8
Multiparous	114 (76)	102 (79)	
Smoking	14 (10)	7 (5)	0.2
Mode of conception			
Spontaneous	6 (26)	2 (12)	0.6
IUI	2 (9)	2 (12)	
IVF	15 (65)	13 (76)	
Multiple gestation	8 (5)	4 (3)	0.3
Medical comorbidities			
Chronic hypertension	17 (12)	24 (19)	0.09
Diabetes	18 (12)	17 (13)	0.8
Non-AMA indication for antenatal testing	49 (33)	57 (45)	0.06
Gestational age at delivery (weeks) ^a	39.1 [37.4–39.8]	38.7 [37.0–39.7]	0.1
Birth weight (g) ^b	3,296 (593)	3,158 (742)	0.09
Birth weight < 10th percentile	12 (8)	17 (13)	0.18

Abbreviations: AMA, advanced maternal age; IUI, intrauterine insemination; IVF, in-vitro fertilization.

Note: All numbers are reported as number (%) unless otherwise specified.

^aMedian (IQR).

^bMean (± SD).

Table 2

Risk of cesarean delivery among AMA women before antenatal testing change (unexposed) and after antenatal testing chance (exposed)

	Cesarean rate among unexposed <i>n</i> (%)	Cesarean rate among exposed <i>n</i> (%)	OR	CI	<i>p</i> -Value	aOR	CI	<i>p</i> -Value
All women (<i>n</i> = 276)	57 (39)	68 (53)	1.76	1.09–2.84	0.02	1.85 ^a	1.05–3.28	0.04
Excluding previous cesarean (<i>n</i> = 217)	36 (30)	39 (40)	1.57	0.89–2.76	0.1	1.70 ^b	0.91–3.18	0.09

Abbreviations: AMA, advanced maternal age; aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

^a Adjusted for race, previous cesarean delivery, multiple gestation, and parity.

^b Adjusted race, multiple gestation, and parity.