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Maternal Complications Associated with Stillbirth Delivery: a Cross-Sectional Analysis

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Abstract

This study sought to identify delivery complications associated with stillbirth labor and delivery. We conducted a retrospective chart review evaluating stillbirth demographics, pregnancy and maternal risk factors, and complications of labor and delivery. We performed bivariable analysis and multivariable logistic regression to evaluate factors associated with medical complications and variations by race. Our cohort included 543 mothers with stillbirth, of which two-thirds were African-American. We noted high rates of shoulder dystocia, clinical chorioamnionitis, postpartum hemorrhage, and retained placenta in women with stillbirths. 33 women (6%) experienced at least one serious maternal complication. Complication rates did not vary by maternal race. Providers who perform obstetrical care should be alert to the high rate of maternal medical complications associated with labor and delivery of a stillbirth fetus.

Keywords

stillbirth; fetal death; obstetrics; labor and delivery; morbidity; complications

Introduction

There has been little investigation of how labor and delivery proceed after fetal death diagnosis and few articles have highlighted potential risks of stillbirth delivery.(Habek 2008, Prabhu & Panayotidis 2008, Steel *et al.* 2009) Guidelines from the American College of Obstetricians-Gynecologists discuss labor induction but not the most common risks of stillbirth deliveries.(American College of Obstetricians and Gynecologists 2009) Such

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complications can affect obstetrical management, maternal health, and risks in subsequent pregnancies. Anticipating the risks can lead to improved quality of care for mothers and management of adverse outcomes.(Becker *et al.* 2013, Mhyre *et al.* 2011)

Despite great progress in reducing fetal deaths in the United States, there remains one stillbirth (20+ weeks gestational age) per 160 live births.(Macdorman & Kirmeyer 2009) Stillbirth is generally reported in the U.S. as death of a fetus at or after 20 weeks gestational age and in some states includes a minimum birth weight of 350-500 grams.(MacDorman *et al.* 2012) African-American women face twice the risk for stillbirth for reasons that are not entirely clear.(Macdorman & Kirmeyer 2009, Willinger *et al.* 2009) The primary goal of this study was to identify delivery complications associated with a large cohort of stillbirth deliveries with secondary goals of evaluating the impact of race on stillbirth care and delivery.

Methods

We reviewed medical records for stillbirth deliveries between 1996 and 2006 at three large academic hospitals in southeastern Michigan. The three hospitals together account for 12,000 deliveries per year, and two of the three hospitals serve predominantly African-American populations. This study was approved by the institutional review boards of all the participating hospitals.

Stillbirths in this cohort were defined as fetal deaths prior to delivery at or greater than 20 weeks gestational age without regard for weight. At two of the smaller hospitals, we collected information on all stillbirths from 1996-2006. At the third hospital where patients were predominantly African-American, we selected a random sample of charts over the 10-year period with purposeful oversampling of non-African-American women as a secondary goal of the study was to assess whether there were racial variations in care and delivery. The unit of analysis was the pregnancy and delivery, regardless of a singleton or multiple gestation. Complications were identified if they were listed in the patient's medical record in progress notes, included in the labor/delivery record, or we identified a billing code for the specific complication.

Undergraduate and graduate research assistants were trained in chart abstraction until they achieved 90% concordance with the primary investigator (a physician). Charts were re-abstracted or reviewed by the primary investigator for abstraction accuracy. Data was double-entered into a database and analyzed with Stata SE 10.1 (College Station, TX).

Summary statistics for maternal demographics included age, race, marital status, and insurance type based on hospital codes on intake forms. We also collected information on parity, trimester of prenatal care initiation, route of delivery, and paternal demographics. Gestational age was determined by the official delivery record and reflected age at time of delivery, which was not necessarily age at time of fetal death. Mean gestational age was categorized as early (20-27 6/7 weeks) or late (28 weeks and beyond). The definition of intrauterine growth restriction was based on published growth charts showing growth less than 10th percentile for assigned gestational age and gender.(Alexander *et al.* 1996) We also

extracted data about maternal medical and obstetrical histories, prenatal care, labor and delivery methods and complications, length of stay, hospital charges, cause of death (if identified) and results from any cause of death evaluation.

For primary outcomes, we calculated summary statistics for rate of cesarean section, episiotomy, third or fourth degree vaginal laceration, shoulder dystocia, breech delivery, postpartum hemorrhage and retained placenta (defined 30 or more minutes to placental delivery after delivery of the infant).

For secondary outcomes, we defined a category of “serious maternal complications” encompassing those which conferred significant morbidity or mortality to the mother. In this category we included the following: disseminated intravascular coagulation, blood loss requiring transfusion, shock or hypotension, renal failure, respiratory failure requiring intubation, diabetic ketoacidosis, sepsis, uterine rupture, unplanned hysterectomy, or maternal death. We elected to combine the serious complications into composite measure since the incidence of any single serious event is low and we believed a composite would be more clinically meaningful.

Finally, in our secondary outcomes, we recorded complications which could be either a contributor to IUFD or consequence of delivery as secondary outcomes including clinical chorioamnionitis when chart notes indicated a specific diagnosis or treatment for chorioamnionitis during the intrapartum course. We excluded cases of histologic chorioamnionitis, amnionitis, or funisitis without clinical confirmation. As we did not have postpartum records for most patients, we did not record rates of endometritis.

Bivariable analysis using chi-squared was used to compare delivery complications between early versus late stillbirth and the impact of nulliparity. We also evaluated whether the complications varied by maternal race (Caucasian versus Black/African-American). For serious maternal complications, we performed multivariate logistic regression to control for potential confounders including all of the demographic and pregnancy variables listed in Table 1. We set level of significance at 0.05.

Results

543 mothers with stillbirth were included in our cohort. (Table I) Two-thirds of the mothers were African-American, which reflected the population served by the hospitals in our study and our purposeful sampling. Most women were unmarried and multiparous. Approximately half had public health insurance or no insurance and 53% initiated prenatal care in the first trimester. The median gestational age at delivery was 28 weeks (mean 29 weeks $\pm$ 6.5 weeks). Median birth weight of all fetuses was 800 grams (mean 1318 grams $\pm$ 1116 grams) with 37% of fetuses categorized as intrauterine growth restricted. Approximately two-thirds of cases were identified as having no fetal heartbeat prior to the onset of active labor. In the other cases, the mother was in labor at the time of IUFD diagnosis, so timing of the actual demise was not known. The overwhelming majority of mothers (97%) were admitted for induction or delivery within two days of diagnosis of the fetal demise.

The types of complications seen in this cohort are outlined in Table II. Cesarean delivery occurred in 44 (8%) of cases, and 30 of these women did not have a trial of labor. Of these 30 cases, 9 were considered emergent sections and another 18 women had a history of prior section. All three remaining women had medical indications for cesarean delivery (placenta previa, prior myomectomy). For all 114 women in the cohort with a prior cesarean delivery, 93 (81%) had a trial of labor after cesarean and 87 (76%) had successful vaginal delivery of their stillborn infant.

Breech presentation was observed in 148 deliveries (27%), with a 91% vaginal delivery rate in this subgroup. Postpartum hemorrhage was recorded in 53 (10%) of cases, and retained placentas in 124 (23%). Shoulder dystocia occurred in nearly one in twenty stillbirths. None of these complications occurred at significantly different rates between Caucasian and African-American women and all were more frequent than expected in the liveborn population. Multiparous women were significantly more likely than primiparous women to experience postpartum hemorrhage (11% versus 4%, $p=0.018$) and retained placenta (25% versus 16%, $p=0.034$). Episiotomy and perineal lacerations were infrequent in this cohort.

Differences in complication rates for early versus late stillbirths were as expected with fewer episiotomies and lacerations. Six percent of late gestational age fetuses had a shoulder dystocia compared with two percent of early fetuses. Breech deliveries, however, were more common in earlier stillbirths; Forty-two percent of early gestational age fetuses delivered breech versus 16% of late gestational age fetuses. ($p<0.0005$). A high rate of retained placenta was observed in both sub-groups but more common in the early group (37% early versus 11% late, $p<0.0005$).

Clinical chorioamnionitis was considered a secondary complication since this might have contributed to the fetal demise or might be a complication of the delivery itself. Chorioamnionitis was extremely common among women with IUFD, occurring in a quarter of cases and not surprisingly, was more frequent among those who had ruptured membranes at the time of hospital admission (43% versus 22%, $p<0.0001$) and in early versus late stillbirth (32% versus 21%, $p=0.006$).

Overall, 33 women (6%) experienced at least one of the 10 serious maternal complications we measured (Table III). Risk factors for developing any one of the serious maternal complications were evaluated controlling for maternal age, race, marital status, insurance type, parity, trimester of prenatal care initiation, vaginal versus cesarean delivery, gestational age, and fetal weight. Later onset of prenatal care was associated with a higher rate of maternal complications. Compared with women who initiated prenatal care in the first trimester, starting care in the second trimester increased the odds of serious maternal complication (OR:3.5, CI:1.18-10.38; $p=0.024$), as did onset of care in the third trimester (OR:10.3, CI:2.41-43.59; $p=0.002$), or no prenatal care at all (OR:7.95, CI:2.07-30.46; $p=0.002$). The risk of having a serious maternal complication did not vary significantly by race, parity, or early versus late stillbirth. Although postpartum hemorrhage was noted in 10% of the cohort, only 14 (3%) required transfusion.

The one maternal death in this cohort was associated with respiratory failure and cardiopulmonary arrest; the fetus was diagnosed as IUFD on admission and the mother died with the infant undelivered despite maternal intubation and cardiopulmonary resuscitation at the hospital. The two cases of uterine rupture occurred in women with prior cesarean sections; one patient was admitted with ruptured membranes, not in labor, and was diagnosed with IUFD at the time of admission. The patient was augmented, labored, failed to progress, and then had a caesarean section where the rupture was diagnosed. The other patient was admitted with intact membranes, not in labor, suspected abruption, and fetal death on admission; she went directly to cesarean section without laboring; uterine rupture along the prior uterine scar was confirmed at delivery and identified on the chart as the cause of fetal demise. Overall, out of 114 women with a prior cesarean section 87 (76%) were able to deliver vaginally.

Discussion

Our study reviews complications associated with stillbirth delivery from a large cohort of women, with a high percentage of African-American mothers. We found an increase in shoulder dystocia, postpartum hemorrhage, and retained placenta. This population also had a very high rate of clinical intrapartum infections. We did not observe an impact of race on the rates or types of complications noted. As U.S. hospitals do not publicly report all obstetrical complications, Table 2 compares our data to nationally-reported rates in the literature for comparison.

An interesting finding was that more than a quarter of IUFD presented in breech position and nine out of ten of these fetuses had successful vaginal breech deliveries. Breech presentation at term is relatively uncommon, though it is seen more often in preterm deliveries.(Demirci *et al.* 2012) Not surprisingly the early gestational age fetuses were significantly more likely to be breech than later ages. However, since vaginal delivery is no longer common for a breech infant in this country, obstetric providers in training have few opportunities to perform breech vaginal delivery even though these skills may be needed when vaginal delivery is precipitous and malpresentation is undiagnosed. .(American College of Obstetricians and Gynecologists 2006) Although we recognize that a stillbirth will not have the usual muscle tone present in a live infant, stillbirths may still present an important training opportunity for residents and fellows to gain skill in the mechanism of vaginal breech delivery.

Postpartum hemorrhage was seen in 10% of cases and hemorrhage requiring blood transfusion occurred in 3%. This is slightly higher than noted in a previous review of 208 women with IUFD and spontaneous labor or induction which reported a 7% rate of postpartum hemorrhage and a 1% rate of blood transfusion as well as a review of all U.S. inpatient hospitalizations which showed a 1% transfusion rate.(Callaghan *et al.* 2012, Salamat *et al.* 2002) Our higher rate may be due to the use of chart review instead of relying on billing codes exclusively or could reflect different practice patterns for decisions about transfusion threshold. Retained placenta was noted in a very high number of women (23%) which is significantly higher than that of Salamat (2002) which showed a rate of 2-3%

among stillbirth deliveries, but the Salamat data had more narrow inclusion criteria and higher gestational age.(Salamat *et al.* 2002)

The low rate of complications with vaginal delivery in our study confirms this is the safer plan of management for stillbirth fetuses, even for women with prior cesarean section. We report a low rate of uterine rupture, and in at least one of the cases, the rupture likely had occurred before presentation to the hospital as the woman presented with new-onset abdominal pain and fetal demise. This information is consistent with previous research demonstrating that even among women with prior cesarean delivery, there is a high success rate of vaginal birth among women with IUFD.(Ramirez *et al.* 2010)

Episiotomies and perineal lacerations were uncommon in this cohort. This may be a reflection of the fact that about half of stillbirth deliveries were performed for fetuses less than 28 weeks gestational age. Prior small series and case reports describe decapitation and shoulder dystocia as complications related to maceration of a stillborn fetus. (5,6) In this analysis, shoulder dystocia was recorded in about one out of twenty cases, was far more complicated at later gestational ages, and there were no documented decapitations.

Our study has several limitations which need to be acknowledged. First and foremost, this was a cohort study; while the study used matched live births to look at demographics and hospital stay, we did not do full chart abstractions of the live births due to resource limitations. Second, this was a retrospective chart data abstraction and we did not have access to postpartum visits which would have allowed us to evaluate other complications such as endometritis, retained products of conception, and postpartum mood disorders. We did seek multiple sources of data to try to improve capture of all relevant complications, including chart notes, delivery summary, billing codes, and lab or pathology results where available. Third, we were not able to abstract all the stillbirth charts at all three hospitals due to resource limitations; however, since our selection of charts at the third hospital was based on maternal race but random within this group, other sources of bias which would impact our outcomes were limited. Fourth, our secondary outcomes are complications associated with stillbirth but the stillbirth may not be causal; many birth complications have varied outcomes depending on severity, timing, and response, and we have not attempted to identify the specific cause of fetal death in this manuscript. Identifying the time of onset of each complication would be an important next step for research in this area. Fifth, our calculation of growth restriction is based on gestational age at time of delivery and might overestimate incidence of IUGR delivery in cases where the fetus died well in advance of the delivery. Finally, while our study was large and collected data from three separate hospitals, we focused on academic teaching hospitals with a predominantly African-American, low-income population which may not represent the rate of complications among all populations and in other birthing settings.

The study involved an extremely large cohort of stillbirths and has multiple strengths. While many studies of stillbirth have focused on white, upper-middle class patients, our research included a large, racially-diverse cohort of mothers. Our use of data from billing records and medical charts increases the capture rate of stillbirths and may identify complications which are underreported in studies limited to diagnosis and billing data. Our review of every page

of the medical record did allow us to document information which is often missed by billing databases. Additional research would benefit from comparing stillbirths to complications from live births at the same hospital.

The rate of serious maternal complications in our series is of significant concern. Women with IUFD may reflect a higher-risk population generally or patients with late or no prenatal care at all may have higher risk both for stillbirth and serious maternal complications. Kuklina et al (2009) and Callaghan (2012) both reviewed the rates of serious obstetrical morbidities among all women in a national sample of delivery hospitalizations.(Callaghan *et al.* 2012, Kuklina *et al.* 2009) While those studies evaluated a different set of complications than we included, for every complication where comparison was possible (renal failure, blood transfusion, and disseminated intravascular coagulation) we had significantly higher rates in our stillbirth cohort. Our results are particularly striking when consideration is given to the high rate of maternal complications despite a very low cesarean delivery rate. On a global basis, the rate of complications is concerning since 98% of fetal deaths occur in low and middle income countries where there are limited resources to manage birth complications.(Lawn *et al.* 2011)

Conclusions

Stillbirth represents one of the most profound adverse outcomes in obstetrical care. This research demonstrates that it is associated with a host of medical complications for the mother at the time of labor and delivery. Providers should be aware of the potential risks associated with stillbirth deliveries and be prepared to manage these risks to improve maternal outcomes.

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Table I

Maternal Demographics and Pregnancy Information (total n=543)

Variable	n (%)
Maternal age (mean, standard deviation)	28 years (+/-7)
Race --Caucasian --Black or African-American --Asian --Other --Missing	163 (31%) 348 (65%) 20 (4%) 1 (<1%) 0
Marital Status --Single --Married/partnered --Missing	328 (61%) 212 (39%) 3 (<1%)
Insurance --Private --Public --None --Missing	267 (49%) 244 (45%) 25 (5%) 5 (<1%)
Parity --Primiparous --Multiparous --Missing	121 (22%) 422 (78%) 0
Onset Prenatal Care --First Trimester (<14 weeks) --Second Trimester (14-26 weeks) --Third Trimester (>26 weeks) --No prenatal care --Missing	249 (53%) 152 (32%) 30 (6%) 38 (8%) 74 (14%)
Multiple fetuses (twins)	23 (4%)
Gestational Age --median, mean and standard deviation --Early stillbirth: 20-27 6/7 weeks --Late stillbirth: 28+ weeks --Missing (but documentation showed at least 20 weeks)	28 weeks, 29 weeks (+/- 6.5) 240 (44%) 301 (55%) 2 (<1%)
Fetal weight (median, mean, standard deviation)	800 grams, 1318 grams (+/-1116)

Table II

Primary and Secondary Delivery Complications for Stillbirths Compared with National Estimates of Rates in Live Births (n=543)

Complication>	Stillbirths n (%)	Live Birth Estimates (from Literature)
PRIMARY		
Cesarean Section	44 (8%)	29% in 2004 (to match data years)(Menacker <i>et al.</i> 2006)
Episiotomy	13 (2%)	25% (Frankman <i>et al.</i> 2009, Landy <i>et al.</i> 2011)
3 rd or 4 th degree laceration	7 (1%)	3% (Hamilton <i>et al.</i> 2011, Landy <i>et al.</i> 2011, Samuelsson <i>et al.</i> 2002)
Shoulder Dystocia	23 (4%)	1.5% (Dandolu <i>et al.</i> 2006, Hoffman <i>et al.</i> 2011)
Breech delivery	148 (27%)	3% at term (Gardberg <i>et al.</i> 2011, Gilbert <i>et al.</i> 2003)
Postpartum hemorrhage	53 (10%)	3% (Bateman <i>et al.</i> 2010, Callaghan <i>et al.</i> 2010, Lu <i>et al.</i> 2005)
Retained placenta	124 (23%)	3% (Cheung <i>et al.</i> 2011)
SECONDARY		
Clinical chorioamnionitis	142 (26%)	3% (Verani <i>et al.</i> 2010)

Table III

Serious Maternal Complications Associated with Hospitalization for Stillbirth Deliveries (total n=543)

Complication	Women #(%)
Disseminated Intravascular Coagulation	9 (2%)
Blood loss requiring transfusion	14 (3%)
Shock or hypotension	5 (1%)
Renal failure	8 (1.5%)
Respiratory failure requiring intubation	8 (1.5%)
Diabetic ketoacidosis	4 (<1%)
Sepsis	5 (1%)
Uterine rupture	2 (<1%)
Unplanned hysterectomy	2 (<1%)
Maternal death	1 (<1%)
ANY SERIOUS COMPLICATION *	33 (6%)

* Includes any of those listed above since one patient may have multiple complications