Effect of gestational age at first delivery and interpregnancy interval on the recurrence of clinical chorioamnionitis

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BACKGROUND: There is an increased odds of having a recurrence of clinical chorioamnionitis in patients with a diagnosis of clinical chorioamnionitis compared with those without clinical chorioamnionitis in a previous pregnancy. However, it is unclear how gestational age at delivery of the first pregnancy or interpregnancy interval may contribute to this increased risk.

OBJECTIVE: This study aimed to evaluate how gestational age of delivery in a first pregnancy and interpregnancy interval affect the odds of recurrent clinical chorioamnionitis.

STUDY DESIGN: Using maternally linked birth record files, Nulliparous patients from California with at least 2 consecutive deliveries between the gestational ages of 20 and 44 weeks from 2007 to 2012 were identified. The rates of clinical chorioamnionitis in the second pregnancy for patients with clinical chorioamnionitis vs those without clinical chorioamnionitis in the first pregnancy, stratified by the gestational age at delivery of the first pregnancy were determined. As a secondary analysis, the analysis by interpregnancy interval (<18 months vs ≥18 months) was stratified. Corresponding crude and adjusted odds ratios for each stratum were calculated to assess the association of clinical chorioamnionitis in the first and second pregnancies.

RESULTS: Among 31,571 nulliparous patients with clinical chorioamnionitis in the first pregnancy, the frequency of clinical chorioamnionitis in the next pregnancy was 4.0% (1257 cases). This was in comparison with the 1.0% (9177 of 896,154) of nulliparous patients without clinical chorioamnionitis in the first pregnancy who were diagnosed with clinical chorioamnionitis in the next pregnancy (adjusted odds ratio, 2.78; 95% confidence interval, 2.61−2.96). The absolute frequency of recurrence was the highest (54 cases [8.2%]) in those who delivered at 20 to 24 weeks of gestation in the first pregnancy with the diagnosis of clinical chorioamnionitis (adjusted odds ratio, 1.76; 95% confidence interval, 1.25−2.48). For pregnancies delivered at term in the first pregnancy, the frequency of clinical chorioamnionitis in the next pregnancy was higher in those diagnosed with clinical chorioamnionitis in the first pregnancy than in those without clinical chorioamnionitis in the first pregnancy (4.0% vs 1.0%; adjusted odds ratio, 2.85; 95% confidence interval, 2.66−3.05). An interpregnancy interval of <18 months was not associated with increased odds of recurrent clinical chorioamnionitis.

CONCLUSION: The odds of recurrence of clinical chorioamnionitis were the strongest when a patient delivered in the term to postterm period in the first pregnancy, with the absolute risk being the highest when the first pregnancy was delivered in the periviable period (20−24 weeks of gestation). The interpregnancy interval did not seem to modify the risk of recurrent clinical chorioamnionitis.

Key words: chorioamnionitis, intra-amniotic infection, maternal fever, maternal infection

Clinical chorioamnionitis (CC), or intraamniotic infection, is suspected when an intrapartum fever is noted along with maternal leukocytosis, purulent cervical drainage, or fetal tachycardia.[1] It is estimated to affect approximately 2% to 5% of term pregnancies and complicates up to 40% to 70% of preterm deliveries presenting with preterm premature rupture of membranes (PPROM).[1−3]

Chorioamnionitis leads to an increased risk of cesarean delivery

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Why was this study conducted?

Clinical chorioamnionitis (CC) is more likely to occur in patients with a history of the disease, but little is known about what contributes to this recurrence. This study investigated how gestational age of delivery in the first pregnancy and interpregnancy interval (IPI) affected the odds of recurrence.

Key findings

The recurrence of CC was most significant when a patient delivered in the term to postterm period in the first pregnancy (37−42 weeks of gestation), but the absolute risk was the highest when the first pregnancy was delivered in the periviable period (20−24 weeks of gestation). IPI did not contribute significantly to the risk of recurrent CC.

What does this add to what is known?

Gestational age of delivery in the first pregnancy has been found to be a significant risk factor for the recurrence of CC in a subsequent pregnancy.

(CD), endometritis, wound infection, pelvic abscess, bacteremia, postpartum hemorrhage, 5-minute Apgar score of ≤3, and neonatal sepsis.[1,2,4−6] Recent studies have shown an approximate 2- to 3-fold increased odds of CC in a second pregnancy if CC was diagnosed in the first pregnancy.[7,8]

CC is a common indication for preterm delivery. Therefore, it is plausible that earlier gestational age of delivery of a first pregnancy that was complicated by CC is a risk factor for developing CC in a subsequent pregnancy as there may be a predisposition to repeated infection.

In addition, short interpregnancy interval (IPI) has been associated with multiple adverse pregnancy outcomes, such as preterm delivery, low birthweight, and small-for-gestational-age infants.[9−11] However, studies are lacking to assess the potential relationship between a short IPI and a recurrence of CC.

Our objective was to investigate how gestational age of delivery in the first pregnancy affected the odds of recurrence of CC in a second delivery. Secondarily, we aimed to look at how the duration of the IPI affected the odds of recurrence.

Materials and Methods

This prospective cohort study used a previously linked database from California's Office of Statewide Health Planning and Development. The database contains linked birth and fetal death certificates and maternal and infant hospitalization discharge records for births in the state between 2007 and 2012, including across a patient's pregnancies if they had more than one. The Stanford Institutional Review Board approved the study (IRB protocol: 14746). Ethics approval for this study was obtained from the State of California Committee for the Protection of Human Subjects and the Stanford University Research Compliance Office.

We included patients who had at least 2 deliveries at ≥20 weeks of gestation between the years 2007 and 2012 and who were nulliparous at the time of their first delivery during this period. If a patient had >2 deliveries during this period, only the first 2 deliveries were included in the analysis. Only singleton pregnancies between the gestational ages of 20 to 44 weeks who had labored were included. Patients were considered to have labored if vaginal delivery was noted or if there was an indication for a CD after labor, such as a failed trial of labor after CD, arrest of dilation, arrest of descent, or nonreassuring fetal status. Because of their very low risk of CC, we excluded patients who had a scheduled CD in either delivery. A CD was considered scheduled if it did not have the following conditions: fetal distress, cephalopelvic disproportion, induction of labor, prolonged labor, failed operative vaginal delivery, uterine rupture, and/or attempt at vaginal delivery (ie, arrest of dilation or arrest of descent). Other exclusion criteria included records that were missing information on covariates that were used in the multivariate analysis and maternal hospitalizations not linked to birth certificate data.

CC was identified through International Classification of Diseases, Ninth Revision Clinical Modification (ICD-9-CM) codes (658.4, 658.41, 658.42, 659.3, and 762.7) or if the patient was coded for "chorioamnionitis" or "CC" diagnosed during labor or maternal temperature of ≥38°C (100.4°F) on their birth certificate for either of the 2 pregnancies.

We first compared the characteristics of patients who did and did not develop CC in their first delivery. Moreover, we compared the characteristics of those diagnosed with CC in their second pregnancy by their CC status in their first pregnancy to understand if those who were diagnosed with CC twice were distinct from those who were only diagnosed once. Differences between these groups were assessed with chi-square testing.

Next, we calculated the rate of CC in the first pregnancy. Furthermore, we calculated the rates of CC in the second pregnancy, stratified by those with and without CC in the first pregnancy. Crude odds ratios (ORs) and adjusted ORs (aORs) were calculated to evaluate the association between having CC in the first pregnancy and having CC in the second pregnancy. The covariates used to calculate the aORs were measures from the first pregnancy (education and type of insurance) and second pregnancy (maternal age, prolonged rupture of membranes, prolonged labor [defined as >20 hours in labor], epidural, and group B streptococcus (GBS) colonization). We further adjusted for the mode of delivery in both the first and second deliveries (vaginal delivery-vaginal delivery, vaginal delivery-CD, CD-CD, and CD-vaginal delivery).

In addition, we replicated these analyses stratified by gestational age of delivery in the first pregnancy: 20−24, 25−32, 33−36, 37−41, and 42−44 weeks. As a

secondary analysis, we further replicated these analyses stratified by IPI (<18 months vs ≥18 months). The IPI was defined as the period between the delivery of the first pregnancy and the conception of the second pregnancy. The date of conception was calculated on the basis of the gestational age of delivery of the second pregnancy. For this analysis, we excluded any implausible IPI (likely because of a data entry error). An implausible IPI was noted as an interval that was less than 0 days between 2 pregnancies. All analyses were conducted using SAS (version 9.4; SAS Institute, Cary, NC).

Results

There were 927,725 patients with a singleton delivery at ≥20 gestational weeks in their first delivery. Of these patients, 31,571 (3.4%) were diagnosed with CC in their first pregnancy, and 896,154 (96.6%) did not have CC (Figure 1). In examining the second pregnancy, 10,434 patients (1.1%) were diagnosed with CC. Of the 31,571 patients with CC in the first pregnancy, 1,257 (4.0%) were diagnosed with CC in the second pregnancy. This was in contrast with the 9,177 patients (1.0%) who did not have CC in their first pregnancy but were diagnosed with CC in their second pregnancy.

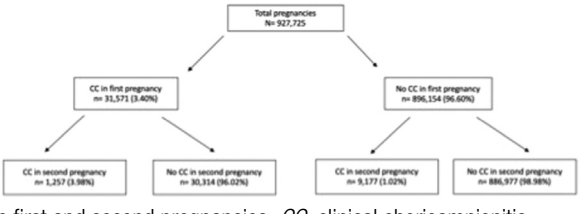
Table 1 shows the characteristics of those with CC vs those without CC in their first pregnancy. Patients diagnosed with CC were more likely to have a CD (22.4% vs 7.1%), be GBS carriers (33.9% vs 22.5%), and have an epidural in labor (30.0% vs 14.8%). Furthermore, patients with CC were more likely to have meconium-stained amniotic fluid, prolonged rupture of membranes, PPROM, stillbirth, and postpartum hemorrhage.

Table 2 shows the characteristics of patients with CC in the second pregnancy, stratified by whether the patient had CC in the first pregnancy. Patients with CC in both the first and second pregnancies were more likely to experience prolonged rupture of membranes, PPROM, postpartum hemorrhage, meconium-stained amniotic fluid, and stillbirth than patients only diagnosed with CC in the second pregnancy and not the first pregnancy. Furthermore, they were more likely to deliver between 20 and 32 weeks of gestation (7.0% vs 1.5%) and had higher frequencies of primary CD (19.6% vs 6.8%) and operative vaginal delivery (7.8% vs 4.3%).

Table 3 shows the frequency of CC in the second pregnancy overall and stratified by gestational age of delivery in the first pregnancy. Those with CC in the first pregnancy had significantly higher odds of being diagnosed with CC in a second pregnancy (aOR, 2.78; 95% confidence interval [CI], 2.61−2.96). The absolute frequency of CC was the highest in those with CC in the first pregnancy with delivery at 20 to 24 weeks of gestation at 8.2% (aOR, 1.76; 95% CI, 1.25−2.48). However, the OR for the association between a history of CC and occurrence in the second pregnancy was the highest in the full-term strata: 37 to 41 weeks of gestation (aOR, 2.85; 95% CI, 2.66−3.05) and 42 to 44 weeks of gestation (aOR, 2.50; 95% CI, 1.93−3.22).

Table 4 shows the frequency of CC in the second pregnancy, comparing those with CC vs those without CC in the first pregnancy, stratified by shorter (<18 months) vs longer (≥18 months) IPI. The IPI did not seem to modify the association between CC in the first and second pregnancies (shorter IPI: aOR, 2.55; 95% CI, 2.35−2.76; longer IPI: aOR, 2.59; 95% CI, 2.39−2.80).

FIGURE 1
Flow diagram of CC.



Rates of CC in the first and second pregnancies. *CC*, clinical chorioamnionitis.

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Discussion

Principal findings

We found that the absolute frequency of recurrent CC was the highest when the first pregnancy was delivered in the periviable period (20 to 24 weeks of gestation), but that the highest OR occurred when the first pregnancy was delivered in the term to postterm period. In addition, we found that the duration of IPI did not affect the recurrence risk of CC, as the odds were increased when a short IPI and a long IPI were analyzed.

Results in the context of what is known

The first investigation into the recurrence of CC did not show an increased risk of diagnosis in a subsequent pregnancy.[12] However, this study was limited by a small sample size of 76 patients and may not have been large enough to detect a difference. More recent studies have shown an approximate 2- to 3-fold increased odds of being diagnosed with recurrent CC,[7,8] which is congruent with our results. However, these studies were also limited in the absolute number of patients who had a recurrence of CC at 131 and 138 patients, respectively. Given that we had 1257 patients who were diagnosed with CC twice, we were able to further investigate gestational age and IPI as risk factors for recurrence.

As expected, the absolute frequency of CC at earlier gestations was higher than at term,[13,14] as this diagnosis is oftentimes the indication for preterm delivery. However, of those who delivered in the periviable period with CC in the first pregnancy, more than 8% of these patients were diagnosed with CC in a subsequent pregnancy, regardless of the gestational age they delivered in a subsequent pregnancy. It is unclear why such increased risk is conferred, but this could potentially be due to dysbiosis of the vaginal flora[15,16] or a persistent

TABLE 1
Characteristics of nulliparous patients diagnosed with CC vs patients without CC in the first pregnancy

Characteristic	CC (n=31,571), n (%)	No CC (n=896,154), n (%)	*P* value[a]
Maternal age (**y**)			<.001
≤18	3159 (10.0)	134,626 (15)	
19–30	19,997 (63.3)	581,011 (64.8)	
31–35	6634 (21.0)	145,356 (16.2)	
36–40	1690 (5.4)	33,515 (3.7)	
≥41	91 (0.3)	1626 (0.2)	
Maternal **r**ace **and e**thnicity			<.001
American Indian **or** Alaska**n** Native	111 (0.4)	4209 (0.5)	
Asian	5101 (16.2)	106,581 (11.9)	
Black	1997 (6.3)	51,702 (5.8)	
Latina	11,493 (36.5)	340,098 (38.0)	
Pacific Islander	2263 (7.2)	33,669 (3.8)	
White	10,527 (33.4)	357,655 (40.0)	
Other	23 (0.1)	491 (0.1)	
Refused to answer **or u**nknown	56 (0.002)	1749 (0.002)	
Gestational age at delivery **(wk)**			<.001
20–24	657 (2.1)	2822 (0.3)	
25–32	981 (3.1)	10,208 (1.1)	
33–36	1791 (5.7)	59,127 (6.6)	
37–41	26,344 (83.4)	772,511 (86.2)	
42–44	1798 (5.7)	51,486 (5.7)	
Mode of delivery			<.001
Spontaneous vaginal	19,215 (60.9)	721,565 (80.5)	
Cesarean	7079 (22.4)	63,929 (7.1)	
Operative vaginal	5277 (16.7)	110,660 (12.3)	
Gestational diabetes **mellitus**	1704 (5.4)	32,270 (3.6)	<.001
Pregestational diabetes **mellitus**	559 (1.8)	11,929 (1.3)	<.001
Chronic hypertension	333 (1.1)	6255 (0.7)	<.001
Cigarette use in pregnancy	606 (1.9)	17,019 (1.9)	.794
Epidural	9484 (30.0)	132,701 (14.8)	<.001
Group B streptococcus positive	10,705 (33.9)	201,636 (22.5)	<.001
Meconium	3141 (9.9)	43,083 (4.8)	<.001
Prolonged rupture of membranes	1899 (6.0)	15,352 (1.7)	<.001
Preterm prelabor rupture of membranes	2494 (7.9)	40,742 (4.5)	<.001
Stillbirth	513 (1.62)	4184 (0.47)	<.001
Postpartum hemorrhage	2115 (6.7)	26,968 (3.0)	<.001

CC, clinical chorioamnionitis.

[a] All comparisons had *P* values of <.001.

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infectious or inflammatory environment,[17] as infection-induced inflammatory pathways involved with bacterial vaginosis or other ascending pathogens have shown an association with preterm delivery.[18] This was further supported by the higher number of patients in our cohort who were colonized with GBS and ended up being diagnosed with recurrent CC.

The strongest association with recurrent CC occurred when the first delivery was at term or in the postterm period. There has been a noted association with an increased relative risk of chorioamnionitis after 40 weeks of gestation.[1] However, it is unclear why patients who have a diagnosis of CC in the term or postterm period in their first pregnancy have higher odds of recurrence in a subsequent pregnancy than patients with a recurrence of CC who have delivered in the preterm period in their first pregnancy. However, some of these occurrences could be related to intrapartum variables in those who labor at term, such as the number of internal examinations or misoprostol use as an induction agent, which could lead to an intrapartum fever and potential overdiagnosis of chorioamnionitis.

In addition, a short IPI is associated with multiple adverse outcomes, including preterm delivery, with increased cytokines present in those with the diagnosis of CC.[19] The biochemistry regarding the etiology of a preterm birth is complicated, and multiple pathways can lead to alterations in triggering of inflammation or anti-inflammation, upregulation of oxytocin receptors, and down-regulation of progesterone receptors, with studies showing a decrease in anti-inflammatory cytokines in those who are affected.[20] Given that CC in the periviable period conferred such a large absolute risk of developing CC in a subsequent pregnancy, we hypothesized that a short IPI would confer a larger risk of developing a recurrence because of a potential state of chronic infection or inflammation. However, we found no significant association between the length of IPI and the recurrence of CC. It is possible that we were underpowered

TABLE 2
Characteristics of patients diagnosed with CC vs patients without CC in the first pregnancy among those who had CC in their second pregnancy

Characteristic	CC in the first pregnancy (n=1257), n (%)	No CC in the first pregnancy (n=30,314), n (%)	*P* value
Maternal age (y)			.09
≤18	11 (0.9)	510 (1.7)	
19–30	650 (51.7)	16,168 (53.3)	
31–35	382 (30.4)	8873 (29.3)	
36–40	183 (14.6)	4171 (13.8)	
≥41	31 (2.5)	592 (2.0)	
Maternal race and ethnicity			<.001
American Indian	3 (0.2)	94 (0.3)	
Asian	205 (16.7)	4840 (16.2)	
Black	113 (9.2)	1842 (6.2)	
Latina	444 (36.1)	10,956 (36.7)	
Pacific Islander	150 (12.2)	2080 (7.0)	
White	316 (25.7)	10,062 (33.7)	
Gestational age at second delivery (wk)			<.001
20–24	26 (2.1)	89 (0.3)	
25–32	61 (4.9)	352 (1.2)	
33–36	77 (6.1)	1758 (5.8)	
37–41	1057 (84.1)	27,266 (89.9)	
42–44	36 (2.9)	849 (2.8)	
Mode of delivery			<.001
Vaginal delivery	698 (55.5)	22,540 (74.4)	
CD, primary	246 (19.6)	2060 (6.8)	
CD, repeat	214 (17.0)	4411 (14.6)	
Operative vaginal birth	99 (7.8)	1303 (4.3)	
Vaginal birth after CD	110 (8.8)	930 (3.1)	
Gestational diabetes mellitus	135 (10.7)	2573 (8.5)	.005
Pregestational diabetes mellitus	25 (2.0)	582 (1.9)	.86
Chronic hypertension	28 (2.2)	393 (1.3)	<.001
Cigarette use during pregnancy	24 (1.9)	509 (1.7)	.53
Epidural	667 (53.1)	12,697 (41.9)	<.001
Group B streptococcus positive	697 (55.4)	14,757 (48.7)	<.001
Meconium	119 (9.5)	1383 (4.6)	<.001
Prolonged rupture of membranes	47 (3.7)	265 (0.9)	<.001
Preterm prelabor rupture of membranes	110 (8.8)	1210 (4.0)	<.001
Stillbirth	14 (1.11)	93 (0.31)	<.001
Postpartum hemorrhage	101 (8.0)	1113 (3.7)	<.001

CC, clinical chorioamnionitis; *CD*, cesarean delivery.

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TABLE 3
The frequency of CC in the second pregnancy stratified by gestational age of delivery in the first pregnancy

Gestational age at delivery in the first pregnancy (wk)	CC in the second pregnancy (n [%])			
	With CC in the first pregnancy	Without CC in the first pregnancy	OR (95% CI)	Adjusted OR (95% CI)[a]
20–24	54 (8.2)	119 (4.2)	2.03 (1.46–2.84)	1.76 (1.25–2.48)
25–32	26 (2.7)	204 (2.0)	1.34 (0.88–2.02)	1.18 (0.78–1.79)
33–36	59 (3.3)	762 (1.3)	2.58 (1.98–3.36)	2.16 (1.65–2.84)
37–41	1042 (4.0)	7493 (1.0)	4.21 (3.94–0.49)	2.85 (2.66–3.05)
42–44	76 (4.2)	599 (1.2)	3.75 (2.94–4.79)	2.50 (1.93–3.22)
Total	1257 (4.0)	9177 (1.0)	4.00 (3.77–4.26)	2.78 (2.61–2.96)

CC, clinical chorioamnionitis; *CI*, confidence interval; *OR*, odds ratio.

[a] Adjusted for education level and insurance type in the first pregnancy and for maternal age, prolonged rupture of membranes, gestational age, prolonged labor, epidural, and group B streptococcus carrier status in the second pregnancy. Adjusted for mode of delivery in the first and second pregnancies.

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to detect an association between extremely short IPIs (ie, IPI of <6 months) and recurrent CC.

Clinical implications

The diagnosis of CC is a risk factor for multiple adverse pregnancy and neonatal outcomes. In a subsequent pregnancy, patients may be interested in knowing how a previous infection may affect their odds of recurrence. Although previous evidence would suggest a 2- to 3-fold increased odds of a recurrence of CC,[7,8] our study provided more granular information about the probability of recurrence based on the gestational age of delivery in the first pregnancy. Furthermore, it may lead to a more timely diagnosis by the care team in recognizing this increased risk for this particular group of patients.

Research implications

Research implications of our work are potentially important in identifying the causes of the high absolute recurrence rate when the index case of CC occurs in the periviable period. For example, if persistent vaginal dysbiosis or persistent infection or inflammation is identified, then interventions might be tested to prevent a recurrence.

Strengths and limitations

The main strength of this study was its large population size with the ability to link maternal and neonatal outcomes across multiple pregnancies to have a more detailed investigation into risk factors that contribute to a recurrence of CC. This study was the largest study to date that we could find in the literature of patients who had CC more than once, which allowed for the investigation into pregnancies that were delivered at different gestational ages with CC in the first pregnancy and the effect of IPI in stratifying risk.

The limitations included the reliance on ICD-9 coding to identify CC. In addition, we were unable to obtain some information regarding known risk factors for CC, such as the number of vaginal examinations performed, length of labor, use of internal monitoring, and oxytocin administration.[21,22]

For this particular study, we only included a patient's first 2 deliveries in the analysis. Given that a risk factor for CC is nulliparity,[1] future studies looking into additional deliveries beyond 2 would be useful in quantifying if an increased odds of recurrence continues throughout more than 2 deliveries or if greater parity dampens this risk.

In addition, although we studied IPI as a risk factor for recurrent CC, we used a cutoff for a short IPI of <18 months. We were potentially underpowered to detect an association between even shorter IPIs (ie <6 months), and this would be another area for further research once more longitudinal data can be collected to be powered to evaluate this outcome.

TABLE 4
The frequency of CC in the second pregnancy by IP of <18 months vs ≥18 months

IPI	CC in the second pregnancy (n [%])			
	With CC in the first pregnancy	Without CC in the first pregnancy	OR (95% CI)	Adjusted OR (95% CI)[a]
<18 mo	459 (3.9)	2577 (0.8)	3.66 (3.39–3.95)	2.55 (2.35–2.76)
≥18 mo	795 (4.0)	6550 (1.1)	3.71 (3.45–4.00)	2.59 (2.39–2.80)

CC, clinical chorioamnionitis; *CI*, confidence interval; *IPI*, interpregnancy interval; *OR*, odds ratio.

[a] Adjusted for education level and insurance type in the first pregnancy and for maternal age, prolonged rupture of membranes, gestational age, prolonged labor, epidural, and group B streptococcus carrier status in the second pregnancy. Adjusted for mode of delivery in the first and second pregnancies.

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Conclusions

We found that the highest absolute odds of recurrent CC was associated with delivery during the periviable period of

20 to 24 weeks of gestation in the first pregnancy. These patients would benefit from extensive counseling regarding the increased odds of recurrence and its implications, and providers should ensure that patients receive adequate contraception counseling if the patient does not accept these risks.

In addition, the odds of experiencing a recurrence of CC was the strongest when a patient delivered in the term to post-term period in their first pregnancy. This information may aid in the identification of CC and lead to a more timely diagnosis and treatment of recurrent infection. ■

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.xagr.2022.100116.

REFERENCES

1. Committee Opinion No. 712: intrapartum management of intraamniotic infection. Obstet Gynecol 2017;130:e95–101.

2. Tita AT, Andrews WW. Diagnosis and management of clinical chorioamnionitis. Clin Perinatol 2010;37:339–54.

3. Newton ER, Prihoda TJ, Gibbs RS. Logistic regression analysis of risk factors for intra-amniotic infection. Obstet Gynecol 1989;73:571–5.

4. Hauth JC, Gilstrap 3rd LC, Hankins GD, Connor KD. Term maternal and neonatal complications of acute chorioamnionitis. Obstet Gynecol 1985;66:59–62.

5. Rouse DJ, Landon M, Leveno KJ, et al. The maternal-fetal medicine units cesarean registry: chorioamnionitis at term and its duration-relationship to outcomes. Am J Obstet Gynecol 2004;191:211–6.

6. Yoder PR, Gibbs RS, Blanco JD, Castaneda YS, St Clair PJ. A prospective, controlled study of maternal and perinatal outcome after intraamniotic infection at term. Am J Obstet Gynecol 1983;145:695–701.

7. Laibl VR, Sheffield JS, Roberts S, McIntire DD, Wendel Jr GD. Recurrence of clinical chorioamnionitis in subsequent pregnancies. Obstet Gynecol 2006;108:1493–7.

8. Cohen-Cline HN, Kahn TR, Hutter CM. A population-based study of the risk of repeat clinical chorioamnionitis in Washington State, 1989-2008. Am J Obstet Gynecol 2012;207:473.e1–7.

9. Conde-Agudelo A, Rosas-Bermúdez A, Kafury-Goeta AC. Birth spacing and risk of adverse perinatal outcomes: a meta-analysis. JAMA 2006;295:1809–23.

10. Ekin A, Gezer C, Taner CE, Ozeren M, Mat E, Solmaz U. Impact of interpregnancy interval on the subsequent risk of adverse perinatal outcomes. J Obstet Gynaecol Res 2015;41:1744–51.

11. Shachar BZ, Lyell DJ. Interpregnancy interval and obstetrical complications. Obstet Gynecol Surv 2012;67:584–6.

12. Dinsmoor MJ, Gibbs RS. Previous intraamniotic infection as a risk factor for subsequent peripartal uterine infections. Obstet Gynecol 1989;74:299–301.

13. Rossi RM, DeFranco EA. Maternal complications associated with periviable birth. Obstet Gynecol 2018;132:107–14.

14. Sherman DJ, Tovbin J, Lazarovich T, et al. Chorioamnionitis caused by gram-negative bacteria as an etiologic factor in preterm birth. Eur J Clin Microbiol Infect Dis 1997;16:417–23.

15. Mass SB, Brennan JP, Silverman N, van Hoeven KH. Association between a shift in vaginal flora on papanicolaou smear and acute chorioamnionitis and preterm delivery. Diagn Cytopathol 1999;21:7–9.

16. Gravett MG, Nelson HP, DeRouen T, Critchlow C, Eschenbach DA, Holmes KK. Independent associations of bacterial vaginosis and *Chlamydia trachomatis* infection with adverse pregnancy outcome. JAMA 1986;256:1899–903.

17. Getahun D, Lawrence JM, Fassett MJ, et al. The association between stillbirth in the first pregnancy and subsequent adverse perinatal outcomes. Am J Obstet Gynecol 2009;201:378.e1–6.

18. Mendling W. Vaginal microbiota. In: Schwiertz A, ed. Microbiota of the human body: implications in health and disease, Cham, Switzerland: Springer International Publishing; 2016:83–93.

19. Simhan HN, Krohn MA, Zeevi A, Daftary A, Harger G, Caritis SN. Tumor necrosis factor-alpha promoter gene polymorphism -308 and chorioamnionitis. Obstet Gynecol 2003;102:162–6.

20. Denney JM, Nelson E, Wadhwa P, et al. Cytokine profiling: variation in immune modulation with preterm birth vs. uncomplicated term birth identifies pivotal signals in pathogenesis of preterm birth. J Perinat Med 2021;49:299–309.

21. Soper DE, Mayhall CG, Dalton HP. Risk factors for intraamniotic infection: a prospective epidemiologic study. Am J Obstet Gynecol 1989;161:562–6.

22. Newton ER. Chorioamnionitis and intraamniotic infection. Clin Obstet Gynecol 1993;36:795–808.