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Major Article

Serious unintended outcomes associated with cesarean section

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Background: Serious unintended outcomes (SUOs) associated with cesarean section (CS), defined in this study as sepsis, endometritis, or wound disruption, occurring during the admission to deliver an infant by CS, or on readmission for wound disruption, are not routinely measured in a manner that continuously evaluates their impact on women's health.

Methods: The Texas Healthcare Information Collection Public Use Data File was used to investigate trends in the diagnosis of SUOs over a 5-year period from January 1, 2010-December 31, 2014.

Results: CS-associated SUOs affected 9.24 women for every 1,000 CSs. During the study period, a large decrease in the rate of SUOs occurred ($R^2 = 0.60$). This was potentially influenced by a large decrease in the rate of endometritis ($R^2 = 0.41$). Decreases in the diagnosis of and readmission for CS wound disruption were not as large ($R^2 = 0.06$ and $R^2 = 0.03$, respectively). A large increase in CS-associated sepsis ($R^2 = .32$) was identified. Administrative coded data used to identify SUOs in this study may have utility for the identification of serious unintended outcomes associated with CS at the population level.

Conclusions: Increases in length of stay and utilization of critical care were noted among women affected by CS-associated SUOs. Additional study is needed to determine factors that increase the likelihood of the development of SUO and to evaluate the preventability of these events.

BACKGROUND

Severe maternal morbidity and mortality are important measures of public health that are regularly measured in the United States.[1,2] The association between cesarean section (CS) and severe maternal morbidity and mortality has been described; however, direct links have not been established.[3] For the purposes of this study, serious unintended outcomes (SUOs) are defined as sepsis, endometritis, and wound disruption occurring during the birth admission or resulting in readmission for wound disruption after the delivery of an infant by CS. Reporting of these events is not required, and these events are not monitored in a manner that continuously evaluates their impact on women's health. Sepsis associated with CS is the result of the bodies response to infection, and endometritis is considered a surgical site infection (SSI).[4,5] Wound disruption may result from poor wound healing and increases the opportunity for infection to develop. Infection is a leading cause of maternal mortality, and SSIs are one of the most common health care–associated infections.[6,7] This study examines trends in the incidence of SUO associated with CS, within the context of severe maternal morbidity and mortality.

Maternal mortality

The 20th century the United States attained a rapid decline in maternal mortality, from 607 deaths per 100,000 women who gave birth in 1915 to 9.2 deaths per 100,000 deaths in 1980. This has been hailed as one of the "Ten Great Achievements of Public Health."[8] Despite these early advances in maternal mortality, a 2015 report prepared by officials at the U. S. Health and Human Services, Health Resources and Services Administration indicated that the maternal mortality rate has steadily risen each year since 1987.[9] Deaths of women are included in the maternal mortality rate if the death occurred within 42 days of the end of a pregnancy, from any nonaccidental cause related to, or aggravated by, pregnancy, regardless of the duration of the pregnancy.[10] In 2011, 17.8 maternal deaths per 100,000 live births occurred. Infection and sepsis were the third leading cause of maternal death after cardiovascular disease, and noncardiovascular disease.[11] In 2011, maternal mortality rate in the State of Texas exceeded the national rate and was 30.74 deaths per 100,000 live births.[12] Epidemiologists speculate that nationally, more accurate reporting of deaths associated with childbirth is responsible for at least some of the increase in maternal mortality.[1,8]

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Severe maternal morbidity

The American College of Obstetricians and Gynecologists has defined severe maternal morbidity as an unintended outcome of labor and delivery that results in short- or long-term health effects for the mother.[13] The Centers for Disease Control and Prevention (CDC) epidemiologists measure severe maternal morbidity by using diagnostic codes included in the National Inpatient Sample to perform retrospective reviews of the medical records of women who have given birth to identify incidences of severe morbidity.[2] The CDC reported that overall a 200% increase in severe maternal morbidity occurred when comparing the years 1993-1994 with 2013-2014. Most of the women included in this measurement were identified because they received blood transfusions. When blood transfusions were excluded as an indicator of severe maternal morbidity, a 34.6% increase was reported.[2]

A major limitation in the analyses of severe maternal morbidity performed by the CDC is the exclusion of complications that occur after discharge from the hospital after delivery. For example, wound disruption resulting in infection after CS may result in an admission to a critical care unit, and this complication is directly related to childbirth. However, if the woman has been discharged home prior to the onset of the infection, the incident would not be included in calculations of severe maternal morbidity.

Study purpose

This study identified trends in incident diagnoses indicating CS-associated SUO over a 5-year period, from January 1, 2010-December 31, 2014, in the State of Texas. For the purposes of this study, SUOs were defined as the presence of a diagnostic code within the discharge record indicating sepsis, endometritis, or wound disruption that occurred during the admission for delivery of an infant by CS, or wound disruption that resulted in readmission to an acute care facility after the CS.

METHODS

A retrospective review of administrative data aggregated in the Public Use Data File (PUDF) by the Texas Healthcare Information Collection (THCIC) was used in this study.[14] Prior to 2015, hospitals in Texas that were located in rural counties with <35,000 residents, or in counties with <100 hospital beds, or that did not accept Medicaid or Medicare payments, were exempted from reporting to the THCIC.[15] Between 2010 and 2014, the Centers for Medicaid and Medicare Services required that diagnosis and procedure codes be assigned using the ICD-9 codes using guidelines published by the National Center for Health Statistics and Centers for Medicare & Medicaid Services.[16,17] Procedural codes were used to identify women who underwent CS. Diagnostic codes were used to define sepsis, endometritis, and wound disruption (Table 1).

Table 1
Codes indicating CS or serious maternal morbidity

Name of code	Numerical indicator
Procedural codes	
CS	74.0, 74.1, 74.2, 74.4, 74.91, 74.99
Diagnostic codes	
Disruption of CS wound	67410, 67412, 67414
Puerperal endometritis	67010, 67012, 67014
Puerperal sepsis	67020, 67022, 67024
Sepsis, severe sepsis	99591, 99592

NOTE. Diagnosis codes were taken from Centers for Medicaid and Medicare Services, 2011.[16]
CS, cesarean section.

Ethical considerations

The study was reviewed by Regulatory Services at the University of Texas at Arlington, and it was determined that the THCIC PUDF was exempt from institutional review. The State of Texas removed dates of service and other indirect identifiers from the PUDF prior to receipt of the data to avoid identification of the patient via deductive disclosure. The study was conducted via data use agreements between THCIC, University of Texas at Arlington, and the researcher.

Inclusion and exclusion criteria

Procedural and diagnostic codes (Table 1) and county of residence, sex, age, and discharge status were used to identify eligible patients. All female residents of Texas who gave birth by CS at a facility that submitted data to THCIC during the study period were eligible for inclusion in the study sample. Records were excluded when (1) the record indicated residence outside of the State of Texas, (2) sex data was missing or invalid, (3) categorical age was <10 years or >60 years, and (4) the patient left against medical advice, or discharge information was missing. If the discharge disposition indicated death, the diagnosis codes were inspected for a diagnostic code indicating one of the SUOs under study. If no applicable code indicating potential SUO was identified, the patient who died was excluded. Records with no procedural code for CS were excluded unless a diagnostic code indicating disruption of the CS wound was present. When the diagnostic code for disruption of the CS wound occurred in the absence of the procedural code for CS, the patient was classified as having been readmitted.

Analysis

Quarterly incidence rates per 1,000 CS procedures were calculated for the aggregate SUOs and for the discrete SUOs (ie, sepsis, endometritis, CS wound disruption). Regression analysis was used to evaluate the trends in these 20 quarters over time. Student *t* test was used to compare the mean length of stay of women without SUO with the mean length of stay among women diagnosed with SUO. Odds ratios (ORs) and 95% confidence intervals comparing care utilization among women with SUO with women not diagnosed with SUO were calculated. SPSS version 23 (IBM, Armonk, NY) and Microsoft Excel (Microsoft, Redmond, WA) were used to perform the analysis.

RESULTS

Records of 627,555 women having a CS and 1,023 women readmitted with CS wound disruption were eligible for inclusion in the study. SUOs were identified in 5,644 records. Discrete SUOs included 3,660 (63 %) incident cases of endometritis, 1,688 (29%) cases of CS wound disruption, and 444 (8%) cases of sepsis. Most women with CS wound disruption were diagnosed on readmission (1,023/1,688; 61%). Table 2 presents incidence rates as an aggregate SUO and for each discrete event by discharge quarter.

A large decrease in SUOs occurred during the study period ($R^2 = 0.60$), and this decrease was potentially influenced by a large decrease in endometritis ($R^2 = 0.41$). Decreases in wound disruption ($R^2 = 0.06$) and readmission ($R^2 = 0.03$) occurred during the study period but were not as large. There was a large increase in the diagnosis of CS-associated sepsis ($R^2 = 0.32$) during the study period (Fig 1).

Thirty-two (7%) of the 444 women diagnosed with sepsis were also diagnosed with endometritis. The odds of women with endometritis also being diagnosed with sepsis were 13 times higher (OR, 13.3; 95% confidence interval, 9.3-19.1) than among women without