JACC: HEART FAILURE
VOL. 3, NO. 3, 2015

ISSN 2213-1779/$36.00
PUBLISHED BY ELSEVIER INC.
http://dx.doi.org/10.1016/j.jchf.2014.10.008

Association of Cardiomyopathy With Adverse Cardiac Events in Pregnant Women at the Time of Delivery

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ABSTRACT

OBJECTIVES The aim of this study was to determine the predictors of adverse events in pregnant women with cardiomyopathy (CDM) and CDM subtypes at the time of delivery.

BACKGROUND Investigation of patients' characteristics and outcomes in women with CDM at the time of delivery has been limited.

METHODS The Healthcare Cost and Utilization Project's National Inpatient Sample was screened for hospital admissions for delivery in pregnant women with CDM from 2006 to 2010. Clinical characteristics and maternal outcomes were identified in women with and without CDM and in CDM subtypes. The primary outcome of interest was major adverse clinical events (MACE), a composite of in-hospital death, acute myocardial infarction, heart failure, arrhythmia, cerebrovascular event, or embolic event.

RESULTS Our study population comprised 2,078 patients with CDM and 4,438,439 patients without CDM. Of those with CDM, 52 (2.5%) were hypertrophic, 1,039 (50.0%) were peripartum, and 987 (47.5%) were classified as other. Women with CDM were older, white, and insured by Medicaid. MACE rates were significantly higher in women with peripartum CDM (46%), compared with hypertrophic CDM (23%) and all others (39%) ($p < 0.001$). In multivariable analysis, the presence of peripartum cardiomyopathy (odds ratio [OR]: 2.2; 95% confidence interval [CI]: 1.1 to 4.6), valvular disease (OR: 2.11; 95% CI: 1.6 to 2.9), and eclampsia (OR: 5.0; 95% CI: 1.6 to 1.9) was independently associated with MACE.

CONCLUSIONS Presence of CDM is independently predictive of MACE during hospitalization for delivery. Patients with peripartum CDM had the highest likelihood of MACE compared with other CDM subtypes. (J Am Coll Cardiol HF 2015;3:257–66) © 2015 by the American College of Cardiology Foundation.

Cardiac complications have consistently been a leading cause of maternal death during pregnancy or delivery among developed nations (1-3). The progression of pregnancy is accompanied by hemodynamic demands on the maternal cardiovascular system and thus poses an increased risk for complications in women with limited cardiovascular reserve (4,5). A growing concern is the presence of pre-existing and new onset cardiomyopathy (CDM) during pregnancy that may result in clinical decompensation with overt heart failure, arrhythmias, and even maternal death, particularly at the time of delivery (6). Delivery of the fetus presents an additional hemodynamic insult for pregnant women with CDM and therefore a period of elevated risk. CDM in pregnancy, including peripartum CDM, has a low incidence, approximately 1 in 3,000 to 1 in 4,000 births (7,8). The incidence of other forms of CDM in pregnancy, including hypertrophic CDM and dilated CDM, is largely unknown, but these types

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Manuscript received March 6, 2014; revised manuscript received September 29, 2014, accepted October 7, 2014.

ABBREVIATIONS AND ACRONYMS

CDM = cardiomyopathy

HCUP = Healthcare Cost and Utilization Project

ICD-9 = International Classification of Diseases-9th Revision

LOS = length of stay

MACE = major adverse cardiac events

NIS = National Inpatient Sample

THC = total hospital charge

are considered uncommon, thus making epidemiological studies on women with CDM challenging. Investigation into the patients' characteristics and outcomes in CDM has been mainly limited to small cohorts of patients (9–12), with only 1 recent study using hospital records pooled from 6 states limited to women with peripartum CDM (13).

In this study, we sought to characterize the incidence of CDM in pregnant women in the United States and to determine the impact of CDM on maternal clinical outcomes and individual predictors of poor outcome at the time of delivery. In addition, we compared multiple types of CDM in terms of clinical characteristics and outcomes.

METHODS

DATA SOURCE. We used data from the 2006 to 2010 National Inpatient Sample (NIS), collected by the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project (HCUP), which is the largest all-payer inpatient publicly available database in the United States (14). The NIS provides annual information on approximately 8 million inpatient stays from about 1,000 hospitals and estimates a 20% stratified sample from a sampling frame that comprises 90% of U.S. acute care hospital admissions. International Classification of Diseases-9th Revision (ICD-9) codes were used to ascertain hospitalizations for delivery, defined as any discharge record with a normal delivery or other indications for care in pregnancy, labor, and delivery-related diagnoses (ICD-9 codes 650 to 659 and V27.4 to V27.9) or delivery-related procedure (ICD-9 codes 72 to 75), as previously described (15). Our analysis was limited to delivery-associated hospitalizations to avoid including multiple hospitalizations for a given patient over the course of an individual pregnancy.

STUDY POPULATION. A total of 39,887,824 hospital discharges were reported to the NIS from 2006 to 2010 from 45 states (1,051 hospitals). We identified a cohort of 5,361,287 pregnant women admitted for delivery (vaginal or cesarean section) at U.S. hospitals. Patients with missing data on race (n = 918,585; 20.6%) and insurance status (n = 7,485; 0.2%) were excluded (n = 920,770; 20.8%), with a remaining study population of 4,440,521. The sample population was broadly separated into patients with CDM ("CDM") and those without CDM ("No CDM"), defined by the presence or absence of the following ICD-9 codes: 674.50 to 674.54; 425.1 to 425.18; 425.0; and 425.2 to 425.9. The CDM cohort was further divided as follows: peripartum CDM (ICD-9 codes 674.50 to 674.54); hypertrophic CDM (ICD-9 codes 425.1 to 425.18); and other CDM (ICD-9 codes 425.0 and 425.2 to 425.9), which includes disorders such as endomyocardial fibrosis, other primary CDM, alcoholic CDM, CDM in other diseases classified elsewhere, and secondary CDM unspecified. Patients diagnosed as having both hypertrophic CDM and peripartum CDM were classified into the hypertrophic CDM group (n = 13), and patients diagnosed as having both peripartum CDM and other CDM were classified into the peripartum CDM group (n = 204).

PATIENT CHARACTERISTICS AND OUTCOME MEASURES. All patient and hospital characteristics were obtained from the NIS. Demographic and medical history data extracted included maternal age, race, insurance status, valvular disease, diabetes mellitus, and delivery at a teaching hospital. The primary outcome of interest was major adverse cardiac events (MACE), defined as a composite of the following: in-hospital death; acute myocardial infarction (ICD-9 codes 410 and 411); heart failure (ICD-9 code 428); arrhythmia (ICD-9 codes 426 and 427); cerebrovascular events (ICD-9 codes 431 and 433 to 436); pulmonary embolism (ICD-9 code 515.1); arterial embolism (ICD-9 code 444); atheroembolism (ICD-9 code 445); obstetric pulmonary embolism (ICD-9 code 673); and cardiac complications of anesthesia or other sedation in labor and delivery (ICD-9 code 668.1). Additional covariates examined included the following: transient hypertension of pregnancy (ICD-9 codes 642.30 to 642.34); mild pre-eclampsia (ICD-9 codes 642.40 to 642.44); severe pre-eclampsia (ICD-9 codes 642.50 to 642.54); eclampsia complicating pregnancy/childbirth (ICD-9 codes 642.60 to 642.64); multiple gestation (ICD-9 code 651); postpartum hemorrhage (ICD-9 code 666); and cesarean delivery (ICD-9 code 74). Valvular heart disease was studied: diseases of the mitral valve (ICD-9 codes 394.0 to 394.9 and 424.0); tricuspid valve (ICD-9 codes 397.0 and 746.89); and aortic valve (ICD-9 codes 395.0 to 395.9).

STATISTICAL ANALYSIS. Data were summarized by descriptive statistics. Chi-square test was used to compare categorical variables, whereas Student *t* test or 1-way analysis of variance was used to compare continuous variables. The 5-year CDM incidence rate per 100,000 deliveries was reported as follows: n, CDM cases / (n, total number of deliveries) × 100,000. Multivariable logistic regression was used to evaluate the association of CDM with MACE while controlling for demographic and medical history. A separate multivariable logistic regression was performed to examine the association of CDM subtype with MACE