OBSTETRICS

Early standardized treatment of critical blood pressure elevations is associated with a reduction in eclampsia and severe maternal morbidity

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BACKGROUND: Hypertensive disorders of pregnancy result in significant maternal morbidity and mortality. State and national guidelines have been proposed to increase treatment of patients with hypertensive emergencies or critically elevated blood pressures. There are limited data available to assess the impact of these recommendations on maternal morbidity.

OBJECTIVE: The purpose of this prospective quality improvement project was to determine if maternal morbidity would be improved using a standardized approach for treatment of critically elevated blood pressures.

STUDY DESIGN: In all, 23 hospitals participated in this project. Treatment recommendations included the use of an intravenous blood pressure medication and magnesium sulfate when there was a sustained blood pressure of ≥160 mm Hg systolic and/or ≥110 mm Hg diastolic. Compliance with the metric recommendations was monitored based on the number of patients treated with an intravenous blood pressure medication, use of magnesium sulfate, and if they received a timely postpartum follow-up appointment. The metric was scored as all or none; missing any of the 3 metric components was considered noncompliant. From January through June 2015 baseline data were collected and hospitals were made aware that ongoing monitoring of compliance would begin in July 2015 through June 2016. The primary outcomes were composite metric compliance, the incidence of eclampsia per 1000 births, and severe maternal morbidity.

RESULTS: During the 18 months of this study there were 69,449 births. Within this population, 2034 met criteria for a critically elevated blood pressure, preeclampsia, or superimposed preeclampsia with severe features. Of this group, 1520 had a sustained critical blood elevation. Initial compliance with treatment recommendations was low (50.5%) and increased to >90% after April 2016 ($P < .001$). Compliance with utilization of intravenous blood pressure medication increased by 33.2%, from a baseline of 57.1-90.3% ($P < .01$) during the last 6 months of monitoring. Compliance with utilization of magnesium sulfate increased by 10.8%, from a baseline of 85.4-96.2% ($P < .01$). The incidence of eclampsia declined by 42.6% (1.15 ± 0.15/1000 to 0.62 ± 0.09/1000 births). Severe maternal morbidity decreased by 16.7% from 2.4 ± 0.10% to 2.0 ± 0.15% ($P < .01$).

CONCLUSION: We noted 3 important findings: (1) compliance with state and national treatment guidelines is low without monitoring; (2) high levels of compliance can be achieved in a relatively short period of time; and (3) early intervention with intravenous blood pressure medication and magnesium sulfate for verified sustained critical maternal blood pressures resulted in a significant reduction in the rate of eclampsia and severe maternal morbidity. The reduction in the rate of eclampsia could only partially be attributed to the increase in the use of magnesium sulfate, suggesting an additive or synergistic effect of the combined treatment of an antihypertensive medication and magnesium sulfate on the rate of eclampsia and severe maternal morbidity.

Key words: blood pressure treatment, eclampsia, preeclampsia, severe maternal morbidity

Introduction

Globally, hypertensive disorders of pregnancy continue to be a significant contributor to maternal mortality and morbidity.[1] While these adverse outcomes are more pronounced in developing nations, they continue to be one of the main contributors to maternal mortality and morbidity in the United States.[2,3] In 2013, the American Congress of Obstetricians and Gynecologists (ACOG) published their Executive Summary on Hypertension in Pregnancy.[4] This document redefined certain aspects of the definition of hypertensive disorders in pregnancy as well as treatment guidelines. The summary supported treatment guidelines for use of medication for hypertensive emergencies where systolic and/or diastolic blood pressure are ≥160/110 mm Hg. These recommendations were further refined in national guidelines (Council on Patient Safety in Women's Health Care)[5] and state toolkits from California,[6] New York,[7] and Florida.[8] Both the national and state organizations took a more aggressive approach toward treatment of hypertensive emergencies or critical blood pressures by recommending that patients be acutely treated if blood pressure values were sustained, defined as persistent values ≥15 minutes apart. They also recommended that these patient be treated with magnesium sulfate for seizure prophylaxis. In an attempt to reduce postpartum morbidity, early follow-up was likewise recommended.

As part of the California Maternal Quality Care Collaborative (CMQCC) toolkit implementation, a group of 24 hospitals, comprising both academic medical centers and community hospitals, agreed to trial the toolkit at their institutions. These 24 hospitals were collectively known as the Preeclampsia CMQCC. One component of the

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collaborative was to test their ability to follow the toolkit guidelines for blood pressure verification and treatment of a confirmed critical blood pressure within 1 hour. Their data suggested that only 41% of sites met this goal.[9] This hospital collaborative went on to show that improving the number of patients treated within 1 hour was associated with a reduction in severe maternal morbidity (SMM).[9] Similarly, treating critical blood pressures as part of a maternal early warning trigger (MEWT) tool resulted in a significant reduction in the rate of eclampsia.[10] The purpose of this investigation was to determine if using key elements from CMQCC and the Council on Patient Safety in Women's Health Care guidelines would reduce the incidence of eclampsia and SMM within a large group of community hospitals. We focused on 3 key elements: (1) treatment of critically elevated blood pressures within 1 hour of verification; (2) use of magnesium sulfate in the presence of critically elevated blood pressures regardless if other criteria for preeclampsia were present; and (3) early postpartum follow-up assessment.

Materials and Methods

This study used deidentified and aggregate data as part of a clinical patient safety monitoring program that was approved by Dignity Health's Institutional Review Board. In May 2014, the 23 hospitals included in this study were provided with recommendations for the management and treatment of preeclampsia and critically elevated blood pressures, which were consistent with CMQCC guidelines designed to reduce maternal morbidity and mortality.[6] Detailed monitoring of utilization of these recommendations was not carried out at that time. During this same time period we initiated a pilot project at 6 hospitals, not include in this report, to test a MEWT tool.[10] The MEWT tool had recommendations for treatment of critically elevated blood pressures identical to those evaluated in this project. Data from the MEWT trial sites suggested the use of these recommendations was associated with a significant reduction in the rate of eclampsia. Similar to the approach that we took in our MEWT trial, patients with blood pressures elevated $\geq$160 mm Hg systolic and/or $\geq$110 mm Hg diastolic were requested to have the blood pressure verified within 15-20 minutes. If the blood pressure elevations were sustained, it was considered a critical blood pressure and treatment with intravenous hydralazine or labetalol using a standard treatment algorithm was recommended.[6,7,10] Blood pressures were rechecked prior to medication administration and, if $<$160 mm Hg systolic and 110 mm Hg diastolic, antihypertensive medication was not administered unless a critical value was reached later in the course of the patient's hospitalization. All patients meeting blood pressure criteria, regardless of the underlying cause of their hypertension, were expected to be treated with magnesium sulfate. Patients with preeclampsia with severe features or superimposed preeclampsia with severe features were also treated with magnesium sulfate per ACOG guidelines.[4] Patients with preeclampsia without severe features could be treated with magnesium sulfate at the discretion of their physician. The final aspect of the process was to make sure all postpartum patients with a diagnosis of a hypertensive disorder of pregnancy were seen within 2 weeks of discharge if they had a hypertension diagnosis, or within 1 week postpartum if they required antihypertensive medication during their admission. Retrospective baseline data were collected from January 2015 through June 2015 to determine baseline compliance with the 3 metric components (blood pressure treatment, magnesium sulfate treatment, and follow-up guidelines). During this same time period from January through June 2015, hospitals were notified that monitoring of compliance and outcomes monitoring were going to begin in July 2015. Educational presentations were made to all of the obstetrics and gynecology departments through the hospital system's annual perinatal meeting, monthly perinatal safety meetings, and webinar presentations. Monitoring of compliance began prospectively in July 2015 and was continued for 1 year. Monitoring was divided into 2 time frames, each 6 months in duration. The 23 hospitals included vary in annual delivery volume from 140 to nearly 5000 births. Data were prospectively collected at each hospital and collated monthly at the central perinatal safety office. Compliance for an individual case was rated as all or none, based on the utilization of all elements or absence of $\geq$1 of the 3 elements being monitored. For example, if a patient received magnesium but not antihypertensive medication if indicated, the case would be considered noncompliant. Similarly, if postpartum follow-up was not made in the specified time period, the case would be rated as noncompliant. System and individual hospital compliance status were presented in monthly perinatal safety World Wide Web–based meetings. Primary outcome data were the rates of eclampsia per 1000 births, the rate of Centers for Disease Control and Prevention–defined SMM (CDC-SMM) per 100 births,[11] and overall compliance with the all-or-none metric. Three time periods were used for analysis: (1) baseline, from January through June 2015; (2) monitoring phase I, July 2015 through December 2015; and (3) monitoring phase II, January through June 2016. To establish a benchmark for evaluating data from the baseline time period, rates of CDC-SMM and the frequency of eclampsia were calculated from data collected from the preceding 2 years (2013 through 2014) and used for comparison.

Data were analyzed by comparing differences between independent populations using an online statistical analysis tool (Vassarstats.net; Richard Lowry, MD, Vassar College, Poughkeepsie, NY). Confidence intervals (90th centile) were calculated using the online statistical analysis tool Confidence Interval Calculator for Proportions (https://www.mccallum-layton.co.uk).

Results

During the 18 months of this project, there were a total of 69,449 births. Of these, 2034 met criteria for treatment with magnesium sulfate. Blood