ORIGINAL ARTICLE

Obstetric Comorbidity Index—A Promising Tool to Predict Maternal Morbidity

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Received on: 22 February 2022; *Accepted on:* 04 July 2022; *Published on:* 22 August 2022

Abstract

Introduction: In India's immense population, the maternal mortality ratio in 2016–2018 was 113. We are still away from the sustainable development goals (SDGs) of MMR less than 70 per 100,000 live births set by the United Nations.[1] In obstetric patients, due to the occasional occurrence of critical conditions, it is hard to identify the initial signs of grievous illness. Focusing on mothers whose comorbidities place them at risk of severe maternal morbidity is a strategy for risk reduction. The obstetric comorbidity index (OB-CMI) is one such tool that summarizes the burden of maternal comorbidities with a quantified approach.

Aim: To evaluate the performance of OB-CMI in identifying women at risk of severe maternal morbidity (SMM) during labor.

Material and methods: We did a retrospective analysis of hospital records of pregnant women >28 weeks gestation admitted to the labor room, in labor, or planned for delivery (January–June 2019). On admission, the OB-CMI was calculated for each patient based on history, examination, and investigations. Any SMM (ACOG and Society for Maternal-Fetal Medicine consensus definition) experienced before discharge was recorded. Association between OB-CMI and SMM was analyzed.

Results: Out of the 1678 women included in the study, 36 women experienced SMM (2.1%). The OB-CMI ranged from 0 to 10, with a median of 0. The median of patients experiencing SMM was 5 as compared to 0 in those who did not (p <0.000). For every 1-point increase in the score, patients experienced a 2.02 increase in odds of severe maternal morbidity (95% confidence interval, 1.75–2.34). The ROC analysis revealed good discrimination between OB-CMI and SMM (0.841, 95% confidence interval 0.752–0.930).

Conclusion: The prevention of SMM is a priority and OB-CMI is a clinically valid tool to identify women at risk during delivery. It is useful as a screening tool, for triaging high-risk patients in specialized institutions that are well equipped. It could also complement physiologic-based screening tools and help in early intervention.

Keywords: Comorbidity, Early diagnosis, High-risk pregnancy, Labor monitoring.

Journal of South Asian Federation of Obstetrics and Gynaecology (2022): 10.5005/jp-journals-10006-2101

Introduction

In India's immense population, the maternal mortality ratio in 2016–2018 was 113. Even though it declined from 122 in 2015–2017, we are still away from the sustainable development goals (SDGs) of MMR less than 70 per 100,000 live births set by the United Nations.[1] In obstetric patients, due to occasional occurrence of critical conditions, it is hard to identify the initial signs of grievous illness. There is a wide range of physiological changes associated with all the organ systems, altering the vital signs, and making their interpretation difficult.[2]

During the antenatal, intrapartum, and postpartum periods, the trajectory of any adverse illness can be a rapid progression from healthy pregnancy to morbidity, which can progress to become severe and then near miss, followed by death.[3]

A healthy pregnant woman will have adequate physiological reserves to compensate for early derangements in the organ systems. But the presence of comorbid conditions and other domains like age, ethnicity, endemic conditions, and absence of access to good healthcare facilities can negatively affect them, resulting in rapid deterioration. There have been many warning systems or Trigger tools to detect derangements at an earlier stage. For example, the maternal early warning criteria and MEOWS chart focus on women with abnormal vital signs who are at risk of unfavorable outcomes. But their specificity and timing challenge their use in any clinical setup.[2,3]

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How to cite this article: Bolanthakodi C, Bhat MS, Huchchannavar RR. Obstetric Comorbidity Index—A Promising Tool to Predict Maternal Morbidity. J South Asian Feder Obst Gynae 2022;14(4):393–399.

Source of support: Nil

Conflict of interest: None

Ethical approval: Approved by Institutional Ethics Committee.

Patient consent: Waiver of consent was obtained from the Institutional Ethics Committee.

Focusing efforts on mothers whose clinical comorbidities place them at risk of severe maternal morbidity (SMM) is an alternative strategy for risk reduction.[4] It is convenient if we have a tool that encapsulates the implications of comorbidities collectively into a

single numerical score. The obstetric comorbidity index (OB-CMI) is one such tool that weighs each comorbidity and condenses it into a single score for analysis.[5,6]

Material and Methods

Study Design

Observational descriptive chart-based study.

Sample Size

Timed-bound study of 6 months duration (January–June 2019)

Methodology

We did a retrospective analysis of the hospital records of pregnant women >28 weeks period of gestation admitted to the labor room, in labor, or planned for delivery. Patients who delivered between January and June 2019 were included. The OB-CMI (refer Appendix A) was calculated for each patient based on the history, examination findings, and investigations on admission to labor room. Any severe maternal morbidity (SMM-American College of Obstetricians and Gynecologists and Society for Maternal-Fetal Medicine consensus definition)[7] experienced by the patients before discharge was recorded (refer Appendix B). The association between the OB-CMI score and the occurrence of SMM was analyzed.

Statistical Analysis

The median of OB-CMI was calculated in the study cohort, in patients who will/will not experience SMM. Using logistic regression analysis, the association between the index and SMM was assessed. C-statistic was calculated to determine the discrimination of the score.

Results

In total, 1678 women of more than 28 weeks gestation, who delivered during the study period were analyzed in the study. Among them, 36 women experienced SMM (2.1%).

The maternal and obstetric characteristics of the study group are represented in Table 1. The women belonged to 18–45 years of age and gestational age of 28–41.3 weeks. About 42% were primigravida and 54.3% had a vaginal delivery.

Table 1: Maternal and obstetric characteristics of the study cohort

Characteristic	*Patients*
Age	27.13 ± 4.39 (18–45) years
Parity	
0	705 (42%)
1	632 (37.7%)
2	234 (13.9%)
3	87 (5.2%)
4	14 (1%)
≥5	4 (0.2%)
Gestational age	37.9 ± 2.13 (28–41.3) weeks
Mode of delivery	
Vaginal	911 (54.3%)
LSCS	527 (31.4%)
Instrumental	240 (14.3%)

The maximum range for the OB-CMI is 0–45. In our study cohort, it ranged from 0 to 10, with a median of 0. The median of patients experiencing SMM was 5 as compared to 0 in those who did not (p <0.000). Figure 1 represents the observed risk of SMM according to OB-CMI score. The prevalence of each OB-CMI score within the study cohort is depicted in Figure 2.

On applying the logistic regression analysis (where the primary outcome was severe maternal morbidity and OB-CMI was the continuous independent variable), for every 1-point increase in the score, patients experienced a 2.02 increase in odds of severe maternal morbidity (95% confidence interval, 1.75–2.34).

The ROC analysis revealed good discrimination between OB-CMI and SMM (0.841, 95% confidence interval 0.752–0.930) (refer to Fig. 3).

Discussion

Critical illness in pregnant or postpartum women is characterized by any medical condition which results in end-organ damage, morbidity, or mortality or if there is a requirement of supportive systems for any of the organ functions in the form of multiple transfusions, mechanical ventilation, and inotropes.[8]

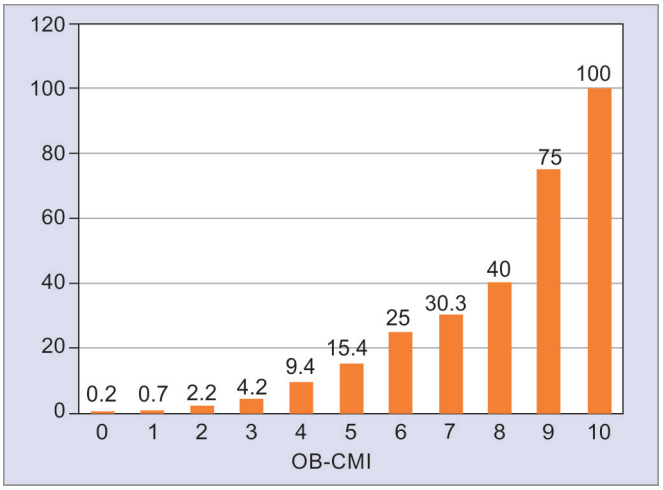

Fig. 1: Observed risk of severe maternal morbidity according to OB-CMI

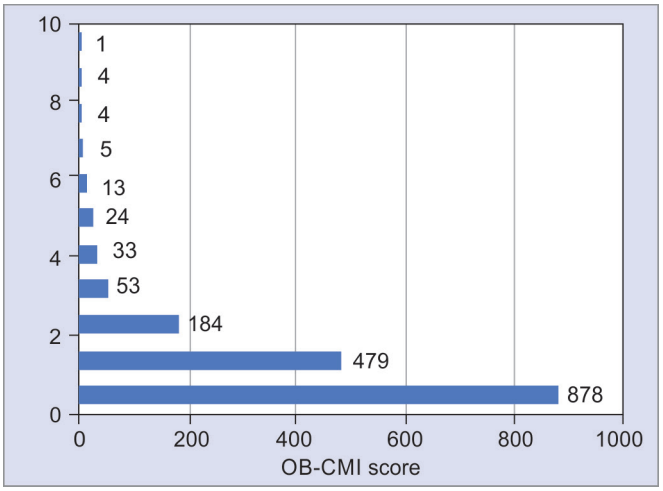

Fig. 2: Prevalence of each obstetric comorbidity index score within the cohort study

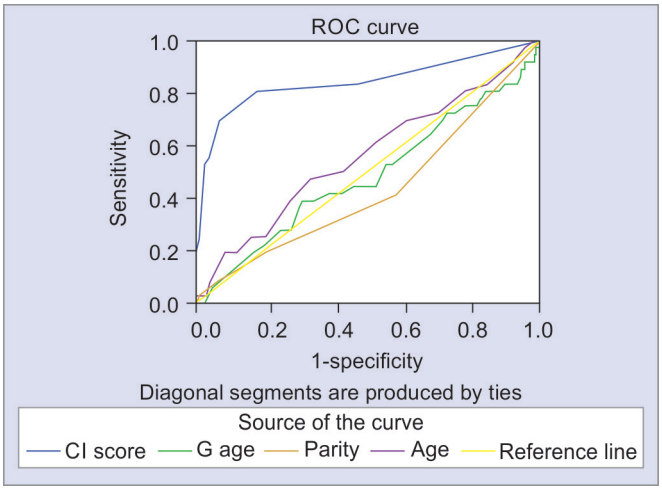

Fig. 3: ROC analysis between OB-CMI and SMM. The ROC analysis revealed good discrimination between OB-CMI and SMM (0.841, 95% confidence interval 0.752–0.930).

About 30–40% of these can be prevented, but there can be subtle and rapid deterioration, putting the patient at risk of death.[9] Tools to monitor a high-risk patient and help in intervening early are not always available. Doctors, nurses, patients, and their families would benefit from a tool that could help in predicting the risk of morbidity/mortality and also assess the level of care required for managing the patient. An ideal tool should be valid across all gestational ages, use commonly available data, easy to use and interpret. In research studies, like observational studies of pregnant women, such tools would also help in adjusting risks and avoiding the confounding factors.

The use of OB-CMI in our study population which was distinct from the original study group, showed a good discrimination of 0.841, in conformity with the various studies done earlier on the comorbidity index in pregnancy.

The OB-CMI was initially derived and validated by Bateman et al. in 2013 to predict severe morbidity and admission to the intensive care unit in pregnant patients.[5] On admission to the hospital for delivery, the index was calculated and correlated with the occurrence of severe morbidity. It included 20 maternal conditions, and the score was calculated based on the weightage given to each of those to reflect the strength of association with maternal morbidity. The index had a moderate discrimination for SMM, c-static – 0.66. There was 37% increase in SMM for every point rise in the score. They also compared the index with other indices like Romano/Charlson Index, Van Walraven/Elixhauser score, and the combined comorbidity score, and found the OB-CMI had significantly better performance. But their study population was from a single source Medicaid Analytic eXtract for the years 2000–2007, and SMM was defined using the International Classification of Diseases (ICD) 9th edition, which has been replaced by a new edition.

Easter et al. used the same OB-CMI index to predict the occurrence of SMM during labor and delivery in 2018.[10] The American College of Obstetricians and Gynecologists and Society for Maternal-Fetal Medicine consensus definition was used for defining SMM. Out of the 2828 women in the study population,1.73% of women experienced SMM. The median OB-CMI score was 1 and 5 in women who had SMM and those who did not, respectively, which was statistically significant (p <0.1). Escalation of SMM from 0.41 to 18.75% was observed when the score increased from 0 to 9. For a hike in every point of the score, there were 1.55 times more odds of SMM. They also found good discriminative capacity for the OB-CMI index, c-static was 0.83 (95% confidence interval, 0.76–0.89).

In 2015, Metcalfe et al. did an external validation of the same OB-CMI in Canada.[6] They had three important inferences: (i) it demonstrated the validity of the score in a population that was different from the original one; (ii) the OB-CMI had a good discriminative capacity to predict SMM by using simple observations and calculations; and (iii) the index can be used when ICD 10 definitions are used. The main outcome assessed was maternal end-organ damage, which was predicted well by the OB-CMI with a discrimination of 0.70.

A systematic review of all existing comorbidity indices used in pregnant women was done by Aoyama et al. in 2017.[11] They critically analyzed the properties and predictive powers of various indices and advocated the OB-CMI as an optimal tool for use by clinicians and researchers in data involving pregnant and postpartum women. They also found that its discrimination capacity was modest, and further evolution of the index for reliability, feasibility, and risk adjustment would be considerations for future research.

Conclusion

Preventing the occurrence of SMM is always a priority to improve quality of life and reduce its progression to mortality. The OB-CMI is a simple tool to consolidate multiple comorbidities and forecast the occurrence of severe maternal morbidity in pregnant and postpartum women. Based on this, appropriate level of care can be assigned to optimize their health and reduce complications. It also could complement physiologic-based screening tools, increase their specificity, and help in an early appropriate action or intervention. In the research settings, it can be used to estimate the burden of comorbidities among different health care providers and even compare regions and countries across the world.

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Appendix A

Obstetric Comorbidity Index Score[10]

Maternal condition	*Points*
Preeclampsia with severe features or eclampsia	5
Preeclampsia/Gestational hypertension/Chronic hypertension	2
Congestive heart failure	5
Pulmonary hypertension	4
Ischemic heart disease/Cardiac arrhythmia	3
Congenital heart and/or Valvular disease	4
Multiple gestation	2
Intrauterine fetal demise	2
Placenta previa/Suspected accreta/Abruption	4
Previous cesarean delivery/Myomectomy	1
Autoimmune disease/Lupus	2
HIV/AIDS	2
Sickle cell disease/Bleeding disorder/Coagulopathy/Anticoagulation	3
Epilepsy/Cerebrovascular accident/Neuromuscular disorder	2
Chronic renal disease	1
Asthma	1
Diabetes in insulin	1
Maternal age >44	3
Maternal age 40–44	2
Substance use disorder	2
Alcohol abuse	1
BMI >50	3
BMI >40	2

Source – Easter et al. OB-CMI for maternal risk assessment. Am J Obstet Gynecol 2019

Appendix B

Diagnoses and complications constituting severe maternal morbidity[7]

Severe maternal morbidity	*Not severe morbidity (insufficient evidence if this is the only criteria)*
Hemorrhage	
Obstetric hemorrhage with 4 units of red blood cells transfused	Obstetric hemorrhage with 2e3 units of red blood cells transfused ALONE
Obstetric hemorrhage with 2 units of red blood cells and 2 units of fresh frozen plasma transfused (without other procedures or complications) if not judged to be overexuberant transfusion	Obstetric hemorrhage with 2 units of red blood cells and 2 units of fresh frozen plasma transfused AND judged to be "overexuberant"
Obstetric hemorrhage with <4 units of blood products transfused and evidence of pulmonary congestion that requires >1 dose of furosemide	Obstetric hemorrhage with <4 units of blood products transfused and evidence of pulmonary edema requiring only 1 dose of furosemide
Obstetric hemorrhage with a return to the operating room for any major procedure (excludes dilation)	
Any emergency/unplanned peripartum hysterectomy, regardless of number of units transfused (includes all placenta accretas)	Planned peripartum hysterectomy for cancer/neoplasia
Obstetric hemorrhage with uterine artery embolization, regardless of the number of units transfused	
Obstetric hemorrhage with uterine balloon or uterine compression suture placed and 2e3 units of blood products transfused	Obstetric hemorrhage with uterine balloon or uterine compression suture placed and 1 unit of blood products transfused
Obstetric hemorrhage admitted to intensive care unit for invasive monitoring or treatment (either medication or procedure; not just observed overnight)	Any obstetric hemorrhage that went to the intensive care unit for observation only without further treatment
Hypertension/Neurologic	
Eclamptic seizure(s) or epileptic seizures that were "status"	
Continuous infusion (intravenous drip) of an antihypertensive medication	
Nonresponsiveness or loss of vision, permanent or temporary (but not momentary), documented in the physician's progress notes	
Stroke, coma, intracranial hemorrhage	
Preeclampsia with difficult-to-control severe hypertension (>160 systolic blood pressure or >110 diastolic blood pressure) that requires multiple intravenous doses, persistent 48 hours after delivery, or both control with oral medications 48 hours after delivery	Chronic hypertension that drifts up to severe range and needs postoperative medication dose alteration: preeclampsia blood pressure
Liver or subcapsular hematoma or severe liver injury admitted to the intensive care unit (bilirubin >6 or liver enzymes >600)	Abnormal liver function requiring an extra prolonged postpartum length of stay but not in the intensive care unit
Multiple coagulation abnormalities or severe hemolysis, elevated liver enzymes, and low platelet count (HELLP) syndrome	Severe thrombocytopenia (<50,000) alone that does not require a transfusion or intensive care unit admission
Renal	
Diagnosis of acute tubular necrosis or treatment with renal dialysis	Oliguria treated with intravenous fluids (no intensive care unit admission)
Oliguria treated with multiple doses of Lasix	Oliguria treated with 1 dose of intravenous fluids (no intensive care unit admission)
Creatinine 2.0 in a woman without preexisting renal disease OR a doubling of the baseline creatinine in a woman with preexisting renal disease	
Sepsis	
Infection with hypotension with multiple liters of intravenous fluid or pressors used (septic shock)	Fever >38.5°C with elevated lactate alone without hypotension
Infection with pulmonary complications such as pulmonary edema or acute respiratory distress syndrome	Fever >38.5°C with presumed chorioretinitis/endometritis with an elevated pulse but no other cardiovascular signs and normal lactate
	Positive blood culture without other evidence of significant systemic illness

Appendix B

Severe maternal morbidity	*Not severe morbidity (insufficient evidence if this is the only severe maternal morbidity criteria)*
Pulmonary	
Diagnosis of acute respiratory distress syndrome, pulmonary edema, or postoperative pneumonia	Administration of oxygen without a pulmonary diagnosis
Use of a ventilator (with either intubation or noninvasive technique)	
Deep vein thrombosis or pulmonary embolism	
Cardiac	
Preexisting cardiac disease (congenital or acquired) with intensive care unit admission for treatment	Preexisting cardiac disease (congenital or acquired) with intensive care unit admission for observation only
Peripartum cardiomyopathy	Preexisting cardiac disease (congenital or acquired) without intensive care unit admission for observation only
Arrhythmia requiring >1 dose of intravenous medication but not intensive care unit admission	Arrhythmia requiring 1 dose of intravenous medication but no intensive care unit admission
Arrhythmia that requires intensive care unit with further treatments	Arrhythmia that requires intensive care unit observation but no extra treatments
Intensive Care Unit/Invasive monitoring	
Any intensive care unit admission that includes treatment or diagnostic or therapeutic procedure	Intensive care unit admission for observation of hypertension that does NOT require intravenous medications
A central line or pulmonary catheter used to monitor a complication	Intensive care unit admission for observation after general anesthesia
Surgical, bladder, and bowel complications	
Bowel or bladder injury during surgery beyond the minor serosal tear	
Small-bowel obstruction, with or without surgery during pregnancy/postpartum period	
Prolonged ileus for 4 days	Postoperative ileus that resolved without surgery in 3 days
Anesthesia complications	
Total spinal anesthesia	Failed spinal anesthesia that requires general anesthesia
Aspiration pneumonia	Spinal headache treated with a blood patch
Epidural hematoma	

Source – Obstetric Care Consensus No. 5. Severe maternal morbidity: screening and review. Obstet Gynecol 2016;128:e54–e60