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Research Article

Impact of Maternal Fetal Medicine Program on Pregnancy Outcomes in Severe Pre-Eclampsia at MTRH Between 2018 and 2022: The Before and After Analysis

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Abstract

Background: *Preeclampsia is a multisystem progressive disorder characterized by the new onset of hypertension and proteinuria or other significant end-organ dysfunction in the last half of pregnancy or postpartum. It complicates 4.6% of pregnancies worldwide. This study set out to describe change in pregnancy outcomes as a consequence of introduction of an educational program.*

Objectives*: To describe the impact of introducing maternal fetal medicine program to pregnancy outcomes in management of pre-eclampsia with severe features*

Methods: *The study was a retrospective cohort chart review of consecutive pregnant women with pre-eclampsia complicated by severe features, before and after the intervention; cared for at Moi Teaching and Referral Hospital - a tertiary referral hospital in Western Kenya, between Jan 2018 and December 2022.*

Results: *A total of 724 charts were reviewed. The two arms were confirmed to be homogenous based on age, parity, gestational age at diagnosis, marital status and risk assessment. Overall, there were better maternal and neonatal outcomes following the educational intervention; more so in improved birth weight, APGAR score at 5-minute, significantly more babies discharged alive from newborn unit. However, there were more caesarian section rates and deranged fetal doppler studies with this intervention.*

Conclusion: *Pregnancy outcomes in severe preeclampsia improved as a consequence of Maternal Fetal Medicine educational program intervention. Subsequently, we recommend support of the intervention for sustainability of favorable outcomes.*

Keywords: *pre-eclampsia, severe features, maternal fetal medicine, educational intervention, maternal outcomes, fetal outcomes*

Introduction

Preeclampsia is defined as new-onset blood pressure elevations accompanied by proteinuria or other signs in pregnancy. It is a pregnancy-specific disease that typically occurs after 20 weeks' gestation. The diagnosis includes at least two measurements of systolic pressures greater than or equal to 140 mm Hg or diastolic pressures greater than or equal to 90 mm Hg.

Epidemiology of Severe Pre-eclampsia

In a systematic review of factors associated with pre-eclampsia/eclampsia in sub-Saharan Africa, Meazaw et al found out that these factors are multifaceted and interdependent. There was strong evidence that being primiparous, previous preeclampsia/eclampsia, family history of preeclampsia/eclampsia, obesity and overweight, chronic hypertension, anemia during pregnancy and lack of Antenatal Care **(**ANC**)** visits. However, other elements that were previously thought to be risk factors were either found to have mixed or inconclusive relationship such as maternal age, maternal level of education, and alcohol intake during pregnancy **(**1**)**. In comparison, an Ethiopian study attributed primiparity and multiple gestation were key associations amongst women found to have pre-eclampsia/eclampsia together with poor nutrition and alcohol ingestion during pregnancy **(**2**)**

The 2019 National Institute for Health and Care Excellence **(**NICE**)** guidelines classify a woman at high risk of preeclampsia if there is a history of hypertensive disease during a previous pregnancy or a maternal disease including chronic kidney disease, autoimmune diseases, diabetes, or chronic hypertension. Women are at moderate risk if they are nulliparous, ≥40 years of age, have a body mass index **(**BMI**)** ≥ 35 kg/m**(**3**)**, a family history of preeclampsia, a multifetal pregnancy, or a pregnancy interval of more than 10 years. These risk factors are echoed in the largest meta-analysis of clinical risk factors to date conducted by Bartsch et al.**(**4**)** who analyzed over 25 million pregnancies from 92 studies. The presence of one high risk factor, or two or more moderate risk factors, is used to help guide aspirin prophylaxis, which is effective in reducing the risk of preeclampsia if administered before 16 weeks of pregnancy **(**5**)**

Optimal Delivery Time and Pregnancy Outcomes

As for timing of delivery, American College of Obstetricians and Gynecologists (ACOG 2020) recommend at or by 34+0 weeks of gestation, after maternal stabilization or with labor or prelabor rupture of membranes.(6) Backes et al reviewed maternal and neonatal outcomes in severe preeclampsia and found out that neonatal and infant mortality rates are consistently higher in late-preterm infants than in term infants. From this study, they concluded that high variability of each case made it difficult to make a general recommendation for the optimal timing of delivery is not possible(7)

Timely delivery in pregnancies complicated by hypertension is a delicate balance between iatrogenic prematurity and maternal end organ damage. It is paramount to weigh the risks of prematurity with its attendant cost against imparting long-term maternal complications.

Preterm birth is characterized by major health and developmental risks for children, life–changing consequences for their families, and substantial healthcare and economic challenges for wider society. Zainal et al in their Tanzanian based study on cost of preterm birth during initial hospitalization - a care provider's perspective suggested optimization of birth weight as a cost predictive factor that can be addressed through measures to prevent or delay preterm birth(8)

Education Intervention: Maternal Fetal Medicine (MFM) Program at Moi University/Moi Teaching and Referral Hospital and Severe Pre-eclampsia Management.

The program was established in September 2019 and it currently offers multidisciplinary care for high-risk pregnancies to optimize outcomes such as in pre-eclampsia. Specific to this study, biweekly assessment of maternal end organ damage together with individualized fetal growth monitoring and determination of optimal time to deliver.

Part of the intervention is to provide state-of-the-art quality level 2 ultrasound, using latest technology in both 2D and 3D/4D for early detection of fetal anomalies from as early as 12 weeks. Unlike general obstetrics, MFM specialists perform much more focused care on women classed as high risk coming in handy especially in follow up. General obstetricians on the other hand work in tandem with MFM team in decision implementation, follow up and referral of cases. Lastly, guiding principles behind MFM at Moi University/MTRH clinical practice are based on several recommendation such as those by American

College of Obstetrician & Gynecologists (ACOG), National Institute of Care in Excellence (NICE), Royal College of Obstetricians & Gynecology, International Society of Ultrasound in Obstetrics & Gynecology (ISUOG) and Society of Maternal Fetal Medicine recommendations.

Objectives: One was to compare sociodemographic characteristics and risk factors of patients diagnosed with severe pre-eclampsia at MTRH in the pre-MFM era (2018-2019) and post-MFM era 2020- 2022; and secondly to determine impact of MFM Program on maternal and fetal outcomes on women being followed up for preeclampsia with severe features at MTRH in the same period

Methodology

Aim, design, and setting

This retrospective study was designed in two arms, where the first comprised of participants who underwent care before the educational program, while the second was post intervention. Moreso, the intervention in question involved risk assessment, institution of low dose aspirin as a pre-eclampsia prevention strategy, early dating and follow up growth scans upon diagnosis of pre-eclampsia with an aim to interrupt pregnancy as close as possible to 37 completed weeks. Additionally, individualized end organ monitoring of renal, liver, hematological and neurologic was instituted. The pregnancy outcomes were compared between the two arms including length of time pregnancy was conserved, mode of delivery and gestational age at delivery, APGAR score at 5minutes, whether the neonate was admitted to new born unit and eventual outcome of both the baby and mother upon discharge. All the patients' files diagnosed to have severe features of pre-eclampsia based on NICE 2019 guidelines on hypertensive disorders in pregnancy were retrieved between 2018 and 2022. In total, 874 patients' files were reviewed of which 724 patients were identified to have met the inclusion criteria.

The study setting was Moi Teaching and Referral Hospital (MTRH), which is the second national referral hospital in Kenya and is in the rural setting of western Kenya. It serves the entire population of western Kenya and has a catchment population of over seven million people. The hospital is in Uasin Gishu County, about 320km northwest of Nairobi – Kenya's capital city.

Characteristics of participants

The study population consisted of consecutive pregnant women with a confirmed diagnosis of severe features of pre-eclampsia, who were attended to in MTRH.

Records of all women with hypertensive disorders in pregnancy who were attended to in MTRH we included. The following records were excluded: Women with pregnancies less than 24 weeks **(**non-viable pregnancy**)**, those that were lost to follow up and those with missing data needed to complete pregnancy outcomes.

Specific variables sought included: Demographic variables, clinical and obstetrics history, preconception care including use of junior aspirin, documented risk assessment and gestational age at diagnosis.

Pregnancy outcomes included length of time pregnancy was conserved, gestational age at delivery, reasons of pregnancy termination, documented maternal end organ derangement and mode of delivery.

Fetal and neonatal outcomes included APGAR score, birth weight, admission to Neonatal Intensive Care Unit **(**NICU**)**/Newborn Unit **(**NBU**)**, neonatal death, and stillbirth. Or whether the neonate was discharged home alive and well.

Study procedures: Data collection, Statistical analysis, and Limitations:

Data collection and definitions

Data was collected using an abstraction sheet and later transferred into STATA software for analysis following data cleaning and verification process.

The primary outcome was optimized pregnancy outcome which comprised of the frequency of maternal end organ derangement, Gestational age at delivery, APGAR score at 5 minutes, and neonatal outcome at discharge.

Secondary outcomes included obstetric and perinatal complications/outcomes such as mode of delivery, length of hospital stay for both mother and neonate, number of investigations performed. Perinatal complications/outcomes included: admission to Neonatal Intensive Care Unit/New Born Unit **(**NICU/NBU**)**, gestational age at delivery and birth weight.

Statistical analysis

The end of 2019 was used as the cut-off date to distinguish between the "before" and "after" periods. Exploratory data analysis was carried out to produce summaries of means, standard deviation, and frequencies. To test for homogeneity between the two-time points, Levene's test was employed to examine the homogeneity of variance centered at the mean for numeric variables, while the chi-square test was used for the categorical variables by period **(**before and after**)**. For small cell samples, fishers exact p-value was read instead of the chi-square p-value. The significant level was taken to be 0.05. For the test of association, for continuous variables t-test was used and for categorical variable chi-square test was used. A sub-analysis of the second arm focusing on women progressing with expectant management beyond 34weeks was performed to ascertain improvement of maternal and neonatal outcomes without adversely affecting maternal end organs while optimizing neonatal results.

Limitations of the study

The study focuses on two stop points, disregarding events that may occur between diagnosis and delivery that may have an impact on timing of delivery such as trends in blood pressure control, maternal and fetal performance status in cases of conservative management prior to delivery.

Results

Demographic characteristics of the sample

The table below presents a summary of the demographic and characteristics and pre-eclampsia risk factors of patients who presented with pre-eclampsia within the period from 2018 to 2022. Test for homogeneity was conducted to check if the two groups were homogeneous. The results shows that there was no difference in the two groups except for the number of hypertensive drugs they were on at the time of diagnosis; where more patients in the “before” reported use of none or more drugs compared to the “after “group.

Characteristics	Before	After	p-value
Continuous variables	Mean(sd)	Mean(sd)	
Age	27.0(8.00)	27.0(8.0)	0.719
Parity	1.3(1.6)	1.3(1.6)	0.290
Gestation at diagnosis (weeks)	35.0(5.9)	35.1(4.5)	0.378
Categorical variables	n(%)	n(%)	
Parity(cat) <= 3 > 3	 360(89.5) 42(10.5)	 286(88.8) 36(11.2)	 0.752
Gestation at diagnosis (cat) Second Trimester Third Trimester	 25(6.2) 369(92.3)	 26(8.2) 292(91.5)	 0.176$^{\tau}$
Number of hypertensive drugs on (cat) 0 1 2 3	 5(1.2) 280(69.7) 91(22.6) 26(7.5)	 16(5.0) 206(64.0) 87(27.0) 13(4.0)	 0.005$^{\tau}$
Marital status Married Single	 310(77.5) 90(22.5)	 245(78.3) 68(21.7)	 0.805
Pre-Eclampsia History Yes No	 66(16.6) 331(83.4)	 70(21.9) 250(78.1)	 0.075
Chronic Hypertension Yes No	 38(9.4) 364(90.6)	 34(10.6) 288(89.4)	 0.621
Diabetes Yes No	 1(0.3) 401(99.7)	 0(0.0) 322(100)	 1.000$^{\tau}$
Autoimmune disease SLE Yes No	 0(0.0) 400(100)	 1(0.3) 321(99.7)	 0.446$^{\tau}$
Pregnancy interval > 10 years Yes No	 16(4.0) 386(96.0)	 5(1.6) 317(98.5)	 0.053
Pre-conception care ordered Yes No	 24(6.0) 378(94.0)	 21(6.6) 299(93.4)	 0.759

$^{\tau}$ *fishers exact test*

Table 1: Summary of Demographic Characteristics and Pre-Eclampsia risk factors

Test for association of selected covariates with the MFM program

Test for the association for the fetal and maternal outcomes before and after the MFM program. The results show that there were significantly more caesarian deliveries in the post-MFM era than before 38.3% vs 51.9% p < 0.001. The mean number of days between diagnosis and delivery reduced significantly in post-MFM program 3.8 vs 2.5 p = 0.017 and there were significantly more deliveries in the second trimester in the after era.

	Before	After	p-value
Maternal Outcomes			
Mode of delivery Vaginal Caesarian	 245(61.7) 152(38.3)	 153(48.1) 165(51.9)	 <0.001
Kidney disease Acute/Chronic No	 2(0.5) 398(99.5)	 0(0.0) 319(100)	 0.506[τ]
Neurological Deficit Yes No	 1(0.3) 308(99.7)	 2(0.8) 236(99.2)	 0.583[τ]
Fetal Outcomes			
Mean and 95% CI of number of days between diagnosis and delivery in days	3.8[3.01-4.6]	2.5[2.0-3.2]	0.017
Gestational age at delivery First trimester Second trimester Third trimester	 11(2.7) 14(3.5) 376(93.8)	 3(1.0) 25(7.8) 291(91.2)	 0.010[τ]
Apgar score Asphyxia Good	 69(17.2) 333(82.8)	 69(21.4) 253(78.6)	 0.147
Admitted to NBU Yes No	 386(96.0) 16(4.0)	 317(98.5) 5(1.5)	 0.073[τ]
Outcome upon discharge if admitted to NBU Alive Dead	 54(13.5) 345(86.5)	 44(13.9) 273(86.1)	 0.893

[τ] *fishers exact test*

Table 2: Association of maternal and fetal outcomes with the MFM program

Sub-analysis of fetal and maternal outcomes by the duration of conservation of pregnancy

Preservation of pregnancy up to 36 or 37 weeks was associated with better birth weight, apgar score at 5 minutes, Doppler and mortality outcomes. Up to 35 weeks was only associated with better mortality outcomes compared to delivery before 34 weeks.

	Delivery upto 34 weeks	Delivery after 34 weeks	p-value
Deliveries conserved for post 34 to 37 weeks			
Mean and 95% CI of actual birth weight	1656.7[1562.0-1751.5]	2423.5[2316.7-2530.4]	<0.001
Apgar score Asphyxia Good	 80(32.1) 169(67.9)	 36(18.3) 161(81.7)	 0.001
Mode of delivery Vaginal Caesarian	 116(47.0) 131(53.0)	 102(53.1) 90(46.9)	 0.200
Deranged Doppler Yes No	 78(34.7) 147(65.3)	 20(13.1) 133(86.9)	 <0.00
Admitted to NBU Yes No	 244(98.0) 5(2.0)	 191(96.9) 3(3.1)	 0.483
Outcome upon discharge if admitted to NBU Alive Dead	 191(77.3) 56(33.7)	 176(90.3) 19(9.7)	 <0.001[τ]
Kidney disease Acute/Chronic No	 2(0.8) 245(99.2)	 0(0.0) 196(100)	 0.506[τ]
Neurological Deficit Yes No	 0(0.0) 232(100)	 0(0.0) 180(100)	
Deliveries conserved for post 34 to 36 weeks			
Mean and 95% CI of actual birth weight	1656.7[1562-175.5]	2237.0[2107.6-2366.4]	<0.001
Apgar score Asphyxia Good	 80(32.1) 169(67.9)	 19(15.6) 103(84.4)	 0.001
Mode of delivery Vaginal Caesarian	 116(47.0) 131(53.0)	 50(42.7) 67(57.3)	 0.449

Deranged Doppler Yes No	 78(34.7) 147(65.3)	 16(16.8) 79(83.2)	 0.001
Admitted to NBU Yes No	 244(98.0) 5(2.0)	 117(95.9) 5(4.1)	 2.43
Outcome upon discharge if admitted to NBU Alive Dead	 191(77.3) 56(22.7)	 111(92.5) 9(7.5)	 <0.001
Kidney disease Acute/Chronic No	 2(0.8) 254(99.2)	 0(0.0) 122(100)	 1.000[τ]
Neurological Deficit Yes No	 3(1.6) 184(98.4)	 0(0.0) 83(100)	 0.555
Deliveries conserved for post 34 to 35 weeks			
Mean and 95% CI of actual birth weight	1656.7[1562.0-1751.5]	2017.6[1848.0-2187.3]	<0.001
Apgar score Asphyxia Good	 80(32.1) 169(67.9)	 14(22.2) 49(77.8)	 0.126
Mode of delivery Vaginal Caesarian	 116(47.0) 131(53.0)	 23(38.3) 37(61.7)	 0.228
Deranged Doppler Yes No	 78(34.7) 147(65.3)	 13(26.5) 36(73.5)	 0.273
Admitted to NBU Yes No	 244(98.0) 5(2.0)	 62(98.4) 1(1.6)	 1.00[τ]
Outcome upon discharge if admitted to NBU Alive Dead	 191(77.3) 56(22.7)	 57(93.4) 4(6.6)	 0.004
Kidney disease Acute/Chronic No	 2(0.8) 254(99.2)	 0(0.0) 63(100)	 0.474
Neurological Deficit Yes No	 3(1.6) 184(98.4)	 0(0.0) 42(100)	 1.000[τ]

Table 3: Sub analysis of fetal and maternal outcomes by duration of conservation of pregnancy

Discussion

The key findings were that MFM educational intervention was associated with less polytherapy of antihypertensives and higher birthweights and better maternal outcomes. Notably, with pregnancy prolongation beyond 34weeks for women with pregnancies complicated by severe features of pre-eclampsia there was no excess risk to the mothers. However, there was a concurrent increase in caesarian rates and doppler derangements with this intervention. Comparatively, according to Norwitz et al, expectant management rather than expeditious delivery is reasonable for selected preterm pregnancies with preeclampsia with features of severe disease to reduce neonatal morbidity from preterm birth, even though the mother and fetus are at risk from disease progression. Expectant management allows administration of a course of antenatal corticosteroids and may provide time for further fetal growth and maturation **(**Preeclampsia: Antepartum management and timing of delivery, UpToDate 2022**)**

In concurrence to this study as pertains benefits accrued as a result of pregnancy prolongations, two small randomized trials comparing delayed delivery with prompt delivery in pregnancies with preeclampsia with severe features **(**based on blood pressure criteria alone**)** at 28 to 32 **(**9**)** and 28 to 34 weeks of gestation **(**Aggressive or expectant management for patients with severe preeclampsia between 28-34 weeks' gestation: a randomized controlled trial,1990**)**, both trials reported significant prolongation of pregnancy and improvement in neonatal outcome with expectant management, with no increase in the rate of maternal complications.

As regards educational interventions and improved outcomes, it is a well appreciated positive enhancement as demonstrated in similar studies such as one by Pankajkumar et al on utilization of educational session on women at risk of anemia as a prevention strategy. They concluded that there was significant improvement in the knowledge regarding anemia and its preventive measures among pregnant women after a single educational session**(**10**)**Compared to this study, it echoes similar findings that educational intervention improves outcomes

Conclusion

Following maternal-fetal medicine educational program, maternal and neonatal outcomes improved significantly over the 3-year period that followed. We recommend continued support and improvement of the same program for sustainability of results.

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