OBSTETRIC HDU: A SUPPLY-BASED ALTERNATIVE FOR ICU CARE IN A LOW-INCOME SETTING: A DESCRIPTIVE STUDY

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ABSTRACT

BACKGROUND: The demand of ICU care for obstetric patients is rising in low-income settings, where there is low ICU-bed capacity. Introduction of obstetric High-dependency unit (HDU) has been described as an effective strategy to bridge this gap in resource-restricted settings.

OBJECTIVE: To describe the clinical characteristic and maternal outcomes of obstetric patients admitted to the first obstetric HDU in Ethiopia.

STUDY DESIGN: This was a descriptive study on clinical characteristics and maternal outcomes of obstetric patients admitted to obstetric HDU over one year (October 2021 to September 2022) at St. Paul's Hospital Millennium Medical College (Ethiopia). Data were collected retrospectively through reviewing patients' medical records using a data extraction format with KOBO collect tool. Data were analyzed using SPSS version 23 and simple descriptive statistics were employed. Proportions and percentages were used to present the results.

RESULTS: After excluding 18 patients who did not meet the inclusion criteria, a total of 355 obstetric patients who were admitted to an obstetric HDU were included in the final analysis. Among these all-obstetric patients admitted to obstetric HDU, pre-eclampsia/ eclampsia (82/355, 23.1%) and postpartum hemorrhage (66/355, 18.6%) were the most frequent reasons for admission to the HDU whereas cardiac disease constituted 14.1% (50/355) of the indication for admissions to the unit.

Majority (318/355, 89.6%) from the study participants were transferred to other wards with im-provement, while 37(7.9%) deteriorated with 9(2.53%) of them died. Septic shock (6/9, 66.6%) and DIC (2/9, 22.2%) were the leading causes of death in the HDU.

CONCLUSION: Findings of our study demonstrate that opening HDU in a low-income setting is feasible and results in favorable maternal outcomes. Introduction of obstetric HDU in low-income settings is an effective intervention to reduce severe maternal morbidity and mortality associated with low ICU-bed capacity in those settings.

KEYWORDS: ICU; maternal mortality; critical obstetric care; Ethiopia; preeclampsia

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INTRODUCTION

Estimates show that 1 in 100 pregnant women suffer a life-threatening event during pregnancy and delivery[1]. The global estimates of maternal mortality for the year 2017 indicate that there were 295 000. Globally MMR in 2017 is estimated at 211 maternal deaths per 100 000 live births, many more suffer varying degrees of acute maternal morbidities resulting in critical maternal illness necessitating critical care at the Intensive Care Unit during pregnancy or puerperium[2]. Although maternal mortality ratio has decreased from 676 per 1000 live births in 2011 to 267 per 1000 live births in 2020[3,4], the rate of maternal death in intensive care units is significant, like in the other of low-income countries.[5]

The concept of HDU has been instituted as a bridge between routine obstetric care and ICU in order to bypass and decrease the ICU burden.[6] HDU care is required for women requiring more detailed observation, intervention including basic support for a single failing organ system, extended post-op care and those stepping down from higher levels of care.[7,8] The presence of a well-developed critical care unit (HDU/ICU) with appropriate infrastructure, equipment's and trained staff is key for providing necessary and timely intensive management to critical mothers.[9] In low-income settings, HDUs may represent frugal innovations incorporating few but essen¬tial lifesaving interventions to critically ill women.[10] With deep understanding of this concept, we recently opened an obstetrics HDU in our hospital (St. Paul's Hospital Millennium Medical College) in Ethiopia. This HDU is the first HDU in Ethiopia, which is well-equipped with mechanical ventilators and ideal critical care personnel.

Though this new obstetric HDU unit in our hospital has been instrumental in decreasing the need for ICU admission among our obstetric patients, it's overall impact in improving the care has never been documented in terms of research. Our study sought to describe the clinical patterns and maternal outcomes of obstetric patients admitted to HDU at a tertiary setting in Ethiopia.

METHODS AND MATERIALS

Study design, study setting, and study period

This was a retrospective descriptive study on clinical characteristics and patient outcomes of obstetric patients admitted to high dependency unit (HDU) at St. Paul's Hospital Millennium Medical College in Ethiopia over 1 year (from October 2021 to September 2022). St. Paul's Hospital Millennium Medical College is a leading national tertiary hospital and medical college in Ethiopia with various sub-specialty care and training available in it, including a Maternal-fetal medicine unit. The hospital attends approximately 10,000 to 11, 000 deliveries per annum and receives one of the highest referral cases that require tertiary level of care, including ICU admission. Often, this hospital is struck with shortage of ICU beds and delay in accessing ICU beds had a detrimental effect on patient outcomes until recently, before we opened the first Obstetrics high dependency unity (HDU) in Ethiopia in 2021, at this hospital. Our positive experience of temporary utilization of mechanical ventilators in our obstetric recovery ward for patients that need intubation in the past, few years prior to the opening this HDU unit when we had ICU bed shortages, was fundamental in making our bold decision to develop a full concept of pioneering obstetric HDC care in Ethiopia. Beyond being the first obstetrics HDU in Ethiopia, our HDU is unique from the other HDU centers across the low-income countries, in that it is well-equipped with mechanical ventilators along with the medical personnel to handle the care. There are 4 beds equipped with oxygen source and vital sign monitors, two mechanical ventilators, advanced high-resolution ultrasound utilized in obstetric and non-obstetric diagnostics including bedside echocardiography. We have 24-hour duty consultant MFM specialist, anesthesiologists, and critical care nurses assigned at the HDU ward. For patients that need multidisciplinary team approach, the

unit has a direct access to consultations from other disciplines including cardiologists, hematologists, and neurosurgeons.

The primary outcome of our study was frequent indications for HDU admission during the study period in our hospital and overall patient outcomes of the study subjects included in the study. We specifically looked into the progress of the patients (whether they have improved or deteriorated, including mortality rate and transfer to ICU), after admission to HDU.

Data collection and Procedures

We accessed medical records for HDU patients included in this study by reviewing our HDU registry. Data for study participants included in this study were collected by reviewing the patient medical records. Data was collected using a simple data extraction format with KOBO collect tool. The data extraction format had 3 sections, socio-demographic data, clinical characteristics of patients, and patient outcomes after admission to HDU. A formal ethical clearance letter was obtained from St. Paul's Institutional Review Board (IRB). The ethical clearance didn't require getting informed consent from study subjects included in this study, hence informed consent was not obtained from the study subjects. The inclusion criteria were: obstetric patients, admitted to HDU, clinical characteristic and patient outcomes are known, antepartum and post-partum patients, and post-abortion patients. The exclusion criteria were stepped down patients from ICU (transferred from ICU for transition before admitted to respective ward).

Statistical analysis

No sample size calculation was used. Patients who were admitted to our HDU during the study period and meet the inclusion and exclusion criteria were included. Data were analyzed using SPSS version 23. Simple descriptive statistics were employed. Proportions and frequency were used to present findings significance.

RESULTS

A total of 355 patients were included in this study after 18 patients were excluded because they did not meet the inclusion criteria. The mean age of the study participants was 28+5.3 years. Majority of the patients were post-partum mothers (306/355, 86.2%) while 20 (5.6%) were pregnant at the time of admission to the HDU. The remaining 29(8.16%) were post abortion patients (Table-1).

Table 1: Clinical characteristics of the participants involved in the study of Admission and outcome of obstetric patients admitted to the obstetrics HDU of SPHMMC, 2021-2022

Variable	Category	n	%
Age(years)	**Mean**	**28+5.3**	
	< 19	13	3.7
	20-34	290	81.7
	35-49	52	14.6
Parity	Nulliparous	15	4.2
	Parous	340	95.8
Condition at admission to Obstetrics HDU	Pregnant	20	5.6
	Postpartum	306	86.2
	Post abortion	29	8.2

Among the indications for HDU admission, pre-eclampsia/ eclampsia (82/355, 23.1%) and postpartum hemorrhage (66/355, 18.6%) were the most common ones while cardiac disease accounted for 14.1% (50/355) of the admissions (Table-2).

Table-2 Indications for HDU admission in Ethiopia, 2021-2-2022

Indication for HD admission	n	%
Preeclampsia /eclampsia related complications	82	23.1
PPH	66	18.6
Post delivery / post- cs observation	53	14.9
Cardiac disease	50	14.1
Others	41	11.6
Sepsis	28	7.9
Abortion related complications	20	5.6
Chronic hypertension	15	4.2

The average length of HDU stay was 1.86 + 2.68 days ranging from 12 hours to 32 days. The majority 318(89.6%) of the study participants were transferred to other wards with improvement, while 37(7.9%) deteriorated with 9(2.53%) of them died. Septic shock (66.6%) and DIC (22.2%) were the leading causes of death in the HDU. The 9 mothers who died in the HDU stayed for 2.1(6 patients stayed for 1, one patient each stayed for 2 days, 5 days, and 6 days respectively). The average length of HDU stay for those mothers who died was 2.11 days ranging from 1 to 6 days.

Table-3: Patient outcomes after HDU admission in Ethiopia, 2021-2022

Outcome	Category	n	%
Length of stay at HDU	**Mean (days)**	**1.86 + 2.68 days**	
Improved	Transferred to other wards or discharged after improvement	318	89.6
Deteriorated	Total	37	10.4
	Transferred to ICU Kept at HDU	18	5.1
	for longer time and transferred to other wards without improvement	10	2.8
	Died	9	2.5

DISCUSSION

In this study, Preeclampsia/eclampsia related complications and post-partum hemorrhage were the most frequent indications for HDU admission. Nine in 10 of patients admitted to our HDU were transferred to other wards after improvement. The death rate among HDU patients was very low, septic shock and DIC being the most frequent immediate causes of death.

Different studies show that the need of ICU admission for obstetric conditions across low-income countries(considered to have a very low ICU bed capacity) is on rising trend.[11,12] Though the pattern of the disease necessitating such admissions influences maternal mortality to a great extent, in general obstetric patients are often young and healthy with their spectrum of sickness being very much reversible with timely intensive care.[13] The introduction of HDU helps to reduce ICU utilization and mortality in obstetric population.[14,15] A recent study of 40,412 deliveries, among which there was a need for ICU care in 447 (1.11%) of the deliveries over a 6-year period found that the rate of ICU admission dropped from 1.59% before the introduction of obstetric HDU to 0.67 after the introduction of obstetric HDU.16 According to some reports, maternal death among obstetric patients admitted to ICU is high in Ethiopia. In a recent case-control study (n=427), obstetrics mortality in intensive care unit was 27% from the total intensive care unit were due to obstetric causes.[5] Although difficult to speculate on the relationship between delay in accessing an ICU bed and risk of maternal mortally based on this study, shortage of ICU bed is often encountered in Ethiopia, like in the rest of the developing countries. Hence, introduction of HDU aiming at improving critical care outcomes for obstetric patients through accessing critical care timely and decreasing the burden of ICU care in our setting is crucial.

The present study found that the majority (1 in 10) of the patients admitted to our obstetric HDU had a favorable outcome. There were 9 deaths among the 355 patients included constituting 2.5%, septic shock and DIC being the main orchestrates of these

deaths. This rate of maternal death in our study is lower than maternal mortality of 4.1% (n=17) found among 413 obstetric patients admitted to HDU in a study done in India.[17] Among the important findings in our study is that Preeclampsia/ eclampsia related complications (82/355, 23.1%) and post-partum hemorrhage (66/355, 18.6%) were the most common reasons for admission to HDU. This finding is consistent with previous reports from UK and India that found hypertensive disorders and PPH as the top indications for HDU admission.[18,19]

We do not have any other study that focused on obstetric HDU in Ethiopia to align with our findings in discussion. However, studies that focused on ICU care outcomes for obstetric patients and maternal death reviews reveal that preeclampsia followed by PPH remain the most frequent indications for admission to ICU as well as the top causes of maternal mortality. Matiyas A. etal found that the leading causes of the direct maternal deaths were hypertensive disorders of pregnancy (32.5%) and postpartum hemorrhage (25%) in his review of 40 in-hospital maternal deaths.[20] Similarly, another study conducted in Ethiopia found that severe preeclampsia was the most frequent indication for ICU admission represented in 35% among the total (225) obstetric ICU patients included in the study. The study also found severe pre-eclampsia (AOR: 6.33; 95% CI: 2.25–17.79) is among factors associated with obstetrics mortality after admission to ICU and further recommended that all pregnant women should have proper antenatal care in order to decrease preeclampsia-related complications through early intervention[5], central to which is preeclampsia prevention through effective screening and providing ASA prophylaxis to those at risk. Recent studies on preeclampsia prevention in Ethiopia also underscore this recommendation. A prospective study of 395 pregnant women with preeclampsia at tertiary hospital in Ethiopia found that 49.4% of them had an indication for preeclampsia prevention intervention however ASA prophylaxis was utilized in less than 2% of them.[21] Though the reasons for this low uptake of ASA prophylaxis for preeclampsia prevention could be multiple, another study shows that there is significant gap in the knowledge and practice of preeclampsia predication and prevention among prenatal care providers attending antenatal care for pregnant mothers in Ethiopia (the mean score of knowledge and practice of prevention for pre-eclampsia using Aspirin among the providers was 42.9[±0.13] and 45.8[±0.07], respectively).[22]

Being the first study in Ethiopia and from the Sub-Saharan region, which may policy-brief the opening of other obstetric HDU units in Ethiopia and beyond in the region is the main strength of this study. Lack of analysis impact of opening HDU on ICU admission rates among obstetric patients and the overall impact of HDU in reducing in-hospital deaths are the major limitation of this study. The retrospective nature of the data and lack of analysis of factors associated with patient deterioration after admission to HDU are the other limitations of this study.

Our study adds useful information on effective utilization of HDU in low-income settings, which is often married by low ICU bed capacity. Being among the first study on this from the Sub-Saharan Africa, it implies that obstetric critical patients who thought to have most of the time reversible causes can access critical care by being admitted to HDU early instead of facing a deterioration in their clinical conditions associated with delays in accessing ICU bed. We underscore that introduction of HDU in low-income settings is an alternative solution to decrease maternal mortality among critically ill obstetric patients. There is a gap in understanding the cost-benefit analysis of introducing obstetric HDU in low-income settings (including care cost for patients and the financial expenses needed to construct such advanced care centers) which should be explored in future studies.

CONCLUSION

Our study shows that opening HDU in a low-income setting is feasible and results in favorable maternal outcomes. Though it did not measure this in terms of reducing in-hospital maternal deaths and need for ICU care among obstetric patients in exact figures, our study supports that introduction of obstetric HDU in low-income settings as an alternative solution to address low ICU-bed capacity which is rampant in such settings.

DECLARATIONS

Ethical consideration

Formal Ethical clearance letter was obtained from Institutional review board of St. Paul Hospital Millennium. The ethical clearance didn't require us to obtain informed consent from patients, hence informed consent was not obtained from the study subjects included in this study.

Conflicts of Interest

The authors report no conflicts of interest (financial or non-financial)

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Authors Contribution

IT, DB, LBT, and AFS contributed conception and development of the study protocol. AFS, DB, and WG contributed data collection and data analysis. AFS, LBT, MB, WG, and DB contributed data interpretation and manuscript write up. The final manuscript was edited by DB , MB, and AFS. All authors critically revised the article for intellectual content. All authors reviewed the final manuscript and approved its submission for publication.

Data Availability Statement

All data generated or analyzed during this study are included in this published article.

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