High Mortality Rate of Obstetric Critically ILL Patients in Rwanda and Its Predictability

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Abstract

Background

Reasons for obstetric admission in intensive care unit (ICU) vary from a setting to another. Outcomes from ICU and its prediction models are not well explored in Rwanda because of lack of appropriate scores. This study intended to assess profile and accuracy of predictive models for obstetric patients admitted in ICU in the two public tertiary hospitals in Rwanda.

Methods

We prospectively collected data from all obstetric patients admitted in the ICU of public referral hospitals in Rwanda from March 2017 to February 2018 to identify reasons for admissions and factors for prognosis. We analysed the accuracy of mortality prediction by the quick Sequential Organ Failure Assessment (qSOFA) and Modified Early Obstetric Warning Score (MEOWS).

Results

Obstetric patients represented 12.8% of all ICU admissions and 1.8% of all deliveries. Sepsis (31.9%) and haemorrhage (25.5%) were the two commonest reasons of admission. Mortality was 54.3% while the average length of stay was 6.6 days. MEOWS was an independent predictor to mortality (adjusted OR=1.25[1.07-1.46]; p=0.005). Similarly, one point of increase of the qSOFA increased odds of ICU mortality by 181% (adjusted OR=2.81[1.25-6.30]; p=0.012). The Area Under the Receiver Operating Characteristic Curve (AUROC) for MEOWS was 0.773[0.666-0.880], p=0.0001 and that of the qSOFA was 0.764[0.654-0.873]; p=0.0001.

Conclusion

Sepsis is the most common reason for obstetric admissions to ICU in Rwanda. MEOWS and qSOFA could accurately predict the mortality for those patients but further explorations on a larger sample size are guaranteed.

Background

Intensive care unit (ICU) admissions in obstetric patients are infrequent and little is known about incidence and outcome in low resources countries. In high and middle income countries, 0.13–0.76% of all deliveries result in maternal ICU admission [1–3], whereas in Sub-Saharan Africa (SSA) the number is 0.24–0.95% [2,4]. Likewise, only 0.65–1.5% of ICU admissions in high and middle income countries are obstetric patients, compared to 1.25–6.7% in Sub-Saharan Africa[1–4].

Various reasons for admission of obstetric patients to the ICU have been identified and the prevalence of each admitting diagnosis varies between countries. Hypertensive disorders and obstetric hemorrhage are predominant among obstetric patients in high and middle income countries, whereas the most common reasons in low income countries in Africa are hemorrhage and sepsis [1,2,4,5].

Mortality among obstetric patients admitted to the ICU remains relatively high in low income countries compared to high income countries. While estimated at 3.5% in Netherlands, it was almost 10 times higher in Kenya and South Africa [4,6,7]. However, the predicting maternal mortality remains challenging as currently used severity scores are not suitable for obstetric patients admitted to the ICU [8–10]. Evidence showed that the Modified Early Obstetric Warning Score (MEOWS) developed by the Confidential Enquiry into Maternal and Child Health (CEMACH) and the quick Sequential Organ Failure Assessment (qSOFA) may help in early detection of physiological derangements[11–13].

There is no specific publication on obstetric admissions to ICU and evidence is lacking that these tools may predict outcome for obstetric patients admitted to ICU in Rwanda. Therefore, this study was conducted to determine the reasons for ICU admissions, outcomes of obstetric patients admitted to ICU, and to evaluate the accuracy of MEOWS and qSOFA in the prediction of mortality for obstetric patients admitted to the ICU.

Methods

The study was conducted in two main teaching hospitals in Rwanda: Centre Hospitalier Universitaire de Butare (CHUB) and Centre Hospitalier Universitaire de Kigali (CHUK) which are tertiary hospitals with total of 448 beds plus 6-bed ICU and 519 bed plus 7-bed ICU respectively. After obtaining ethical approval from the University of Rwanda/College of Medicine and Health Sciences (CMHS) [approval notice No 118 /CMHS IRB/2017], we conducted a prospective cross-sectional study.

We included all women who were admitted to ICU during pregnancy or within 42 days of termination of pregnancy in the study. Patients were followed from admissions to discharge from ICU. A nurse from ICU department collected following data: age, gravida, vital signs, reason for admission, ICU management (duration of stay, inotropes or vasopressors use, blood transfusion, interventions (surgical procedures, ventilation and dialysis) and outcome (mortality or discharge). The duration of stay was calculated in terms of days with zero days for a stay shorter than 24 hours. Vital signs collected were used to manually calculate Modified Early Obstetric Warning System (MEOWS) and quick Sequential Organ Failure Assessment (qSOFA) scores at admission to ICU.

Data were analysed using the Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, version 22.0. Armonk, NY: IBM Corp). Descriptive results were reported as frequency or percentages, mean +/- standard deviation, median and interquartile range (IQR) accordingly. The proportions of obstetric patients admitted to ICU were calculated comparing them to all deliveries reported by both hospitals and all ICU admissions during the study period. Comparison of frequencies or median scores of different variables was made between survivors and non-survivors by using the Chi-square or Mann-Whitney U

tests accordingly. Variables with significant association with the survival rate ($p < 0.250$) were included in a logistic regression model to identify the independent predictors to the mortality. The accuracy for mortality prediction by the independent predictors was evaluated by the Receiver Operating Characteristic Curve (ROC) and the area under the ROC (AUROC) with the 95%CI were calculated. A p-value lower than 0.05 was considered statistically significant.

Results

Demographic data and severity score of obstetric patients at admission to ICU

During the study period, 747 patients were admitted to the ICUs of CHUB and CHUK. Of them, 94 (12.8%) were admitted for obstetric reasons. These obstetric patients were drawn from 4,999 patients admitted to the labour units in the two facilities, corresponding to 1.8% of obstetric patients admitted to ICUs.

Table 1 shows the characteristics of obstetric patients admitted to ICU. The mean age of these patients was 29.8+/-6.5 years, 52 (55.3%) were admitted at their first or second pregnancy and others 44.7% (42) at their third or above, 70 (74.5%) were admitted during the post- partum period, 13 (13.8%) presented after abortion or ectopic pregnancy and 11 (11.7%) were pregnant at the time of admission to the ICU. Of the 70 patients admitted in post-partum period, 44 (62.9%) delivered by cesarean section and 26 (37.1%) had vaginal deliveries.

Table 1
Characteristics of obstetric patients admitted in ICU in our study

Variables	Range	Frequency	Mean±SD
Age (in years)			29.82±6.507
Gravidity at admission to ICU	1-2	52(55.3)	
	≥3	42 (44.7)	
Period of admission	During pregnancy	11 (11.7)	
	Post-abortion/ectopic pregnancy	13 (13.8)	
	Post-partum	70 (74.5)	
Admitted in post-partum period (n=70)			
Mode of delivery	Cesarean section	44 (62.9)	
	Normal delivery	26 (37.1)	

Reasons for admission and interventions done

The most common reason for admission was sepsis (31.9%) followed by obstetric hemorrhage (25.5%), other diseases (20.2%), hypertensive disorders of pregnancy (17.02%) and malaria (5.3%) [Table 2].

Table 2
Reasons for admissions and interventions performed on study patients during their ICU stay

Variables	Number of patients	Percentage (%)
Reason for ICU admissions		
Hemorrhage	24	25.5
Hypertensive disorders of pregnancy	16	17.0
Sepsis	30	31.9
Malaria	5	5.3
Others	19	20.2
Interventions done		
Invasive mechanical ventilation	90	95.7
Blood transfusion	33	35.1
Inotropics/vasopressors support	47	50.0
Re-operation	5	5.3
Hemodialysis	4	4.3

Of the various interventions (Table 2) received by patients admitted in ICU, respiratory support by mechanical ventilation was the main intervention (95.7%), as well as inotropic or vasopressors support (50.0%), blood transfusion (35.1%), re-operation (5.3%) and hemodialysis (4.3%). Some patients received more than one intervention due to severity of disease.

Statistical analysis of outcome, mortality prediction and length of stay in ICU

Analysis of factors associated with survival rate(Table 3) showed that setting, mode of delivery and reasons for admission are not associated with survival rate; there was statistical significant difference with median MEOWS of 7 (IQR:6;8) versus 8 (IQR:6;12), p = 0.001 and same median of qSOFA 2 (IQR: 1;2) between the two groups, p = 0.003). Multivariable logistic regression showed that when adjusted for reason for admission and Caesarean section before admission, MEOWS was an independent predictor of mortality with adjusted OR of 1.25[1.07–1.46]; p = 0.005. Similarly, one point of increase of qSOFA increased odds of ICU mortality by 181% [adj.OR:2.81[1.25–6.30];p = 0.012) [Table 4].

Table 3
Factors associated with survival rate

Variable		N=94	Survivors	Non-survivors	p-value
Setting	CHUK	60	25	35	
	CHUB	34	18	16	0.389
Reason for admission	Hemorrhage	24	11	13	0.078
	Sepsis	30	9	21	
	Others	40	23	17	
Mode of delivery	C-section	44	24	20	0.058
	Vaginal	26	9	17	
MEOWS [Median (IQR)]			7 (6;8)	8(6;12)	0.001
qSOFA [Median (IQR)]			2 (1;2)	2(1;2)	0.008

Table 4
Multivariable Logistic regression for MEOWS and qSOFA/predictors of ICU mortality

Variables		Adjusted OR [95%CI]	p-value
MEOWS		1.25[1.07-1.46]	0.005
Caesarean		0.39[0.12-1.22]	0.106
Reason for admission	Haemorrhage	1 (Ref)	
	Sepsis	1.72[0.42-6.94]	0.449
	Others	0.65[0.18-2.39]	0.517
qSOFA		2.81[1.25-6.30]	0.012
Caesarean		0.33[0.11-1.02]	0.054
Reason for admission	Haemorrhage	1 (Ref)	
	Sepsis	1.50[0.38-5.93]	0.559
	Others	0.88[0.24-3.31]	0.855

Mortality prediction as shown in Fig. 1, with Area Under the Receiver Operation Curves (AUROC) for MEOWS and qSOFA respectively: 0.773 [0.666–0.880] p = 0.0001 and 0.764[0.654–0.873] p = 0.0001. The values in the figure show that MEOWS and qSOFA have fair discrimination capacity for mortality prediction.

The mean length of stay in ICU for obstetric patients was 6.6 ± 7.525 days. During the period of study 51 of 94 obstetric patients admitted to ICU died accounting for the overall mortality 54.3% and 6.8% (51/747) of all ICU patients.

Discussion

This study had the main objective to assess the epidemiology including the profile and outcomes of critical illness among obstetric patients admitted in ICU in public referral hospitals in Rwanda and to evaluate the accuracy of affordable mortality prediction tools that can be used in resource-limited settings. In our findings, obstetric admissions to ICU in public referral hospitals in Rwanda account for 12.8% of all ICU admissions and 1.8% of all deliveries. These rates of ICU admission for obstetric patients are relatively higher compared with those reported in high income countries (0.22–0.76% [1,14,15]. They are rather similar to those found in middle income countries like Brazil (1%) and Turkey (1.27%) [1,14–17]. Our findings are also comparable to that in a study done in Nigeria where obstetric admissions to ICU represented 17.29% and 2.05% of all deliveries [18].

In this study, the rate of ICU admission to all deliveries was 1.8%. It might have been higher given the limited capacity of our ICUs representing only around 1.5% of hospital beds while the ideal number should be more than 10% as it is the case in high income countries [19,20]. This scarcity of ICU beds is shared with other sub-Saharan African countries showing that the number of obstetric patients admitted in ICU falls in a range of 0.24–0.97% [4,7,21]. However, one could argue that, if the number of ICU beds could allow, the number of obstetric patients admitted in ICU in Rwanda could have been increased as the profile of patients admitted in ICU and the severity of the diseases such as the need of ventilators in about 90% and vasopressors for 50% of patients among others. Indeed, the two leading causes of admission to ICU for obstetric patients in Rwanda were sepsis (31.9%) and obstetric haemorrhagic shock (25.5%). These reasons for admission substantially differ from those prevailing in high income countries to partly explain discrepancies in terms of mortality rates as sepsis and septic shock are generally associated with a high mortality in both high income countries like in United states [22] and low income countries including Rwanda[10]. The second commonest cause of admission is hemorrhagic shock and resulting coagulation disorders related to delays to achieve haemostasis, lack of readily available blood products and massive transfusion when these are available may also contribute to the high mortality in obstetric patients in low income countries. Similar findings for main reasons for admission in ICU have been reported in a study conducted in Kenya [4].

The mortality rate in our critically ill obstetric patients was as high as 53.4% but worse outcome has been seen in other sub-Saharan African countries like Burkina Faso where this mortality reached 60% [23]. This poor outcome of our patients may be attributable to the limited capacity of our ICUs on one hand, and to the severity of illness among those admitted in ICU as explained above on the other hand. In contrast to our findings, in the study conducted in Kenya, Githae et al report mortality of 33% of all obstetric admission in ICU and those requiring ventilation and inotropic support were 33% and 30% of obstetric admissions, respectively compared with 95.7% and 50% in our study [4]. The mortality for obstetric

patients admitted in ICU from our study is comparable to one for general ICU patients in Rwanda where it was 48.7% [10]. Data from our study shows that sepsis was highly prevalent and results correlates with the a single centre study in Rwanda where sepsis was the most common causes of morbidity and mortality among obstetric patients admitted in tertiary hospital[24].

A number of mortality prediction tools have been developed for general patients admitted in ICU such as Acute Physiology and Chronic Health Evaluation (APACHE), Simplified Acute Physiology Score (SAPS) and Sequential Organ Failure Assessment (SOFA) however, generalisation to obstetric patients remains challenging [25]. Our study evaluated accuracy of MEOWS and qSOFA in predicting mortality for obstetric patients admitted to ICU and found as easy tools as their components are part of routine clinical assessment. Yet, these predictive tools have good discriminative power with an area under the curve showing their performance (AUROC: 0.773[0.666–0.880], $p < 0.0001$ for MEOWS and 0.764[0.654–0.873], $p < 0.0001$ for qSOFA). Similarly, in a study conducted in Australia among emergency patients with suspected sepsis, it was found that a positive qSOFA (≥ 2 points) identified those at high risk of in hospital mortality or longer ICU stay[26]. In the study done in India, the AUROC showed good discriminative power with qSOFA in predicting mortality (AUROC: 0.73; 95% CI, 0.69–0.77) among septic patients admitted, both in ICU and non-ICU[27]. Above findings have similarities with our study with regards to qSOFA as predictive model, though, our findings are applied in obstetric patients. Our study evaluated accuracy of MEOWS predictive model. Our findings are comparable to the findings in a research conducted in the United Kingdom which showed that MEOWS had high sensitivity and good specificity to early, detect morbidity among obstetric patients outside ICU[12]. Though different setting, MEOWS as a simple bed side model may be applied to obstetric patients at admission to ICU to predict their outcome.

Data for this study were prospectively collected from two tertiary hospitals which may give it strength to be generalizable to whole obstetric population. However, the study has its own limitations such as the small sample size to allow this extrapolation to the general population. To achieve, it would be necessary to collect data for a longer period given the limited number of ICU and ICU beds in the country[28]. Furthermore, it could have been interesting to follow up those patients after their discharge from ICU to also report the mortality at 28 and 90 days but many of them were discharged before those dates and could not be reached anymore.

Conclusion

Hemorrhage and sepsis are major reasons of obstetric admissions to ICU in Rwanda. A relatively high maternal mortality was observed among obstetric patients in ICU. The use of MEOWS and qSOFA as mortality prediction models may help to early recognize obstetric patients at high risk of poor outcome. Further studies with larger sample size are needed to evaluate these affordable tools in that regard for resource limited settings.

Abbreviations

adj. OR: Adjusted Odd ratio

APACHE: Acute, Physiology, Age and Chronic Health Evaluation

AUROC: Area Under the Receiver Operating Characteristic Curve

CEMACH: Confidential Enquiry into Maternal and Child Health

CHUB: Centre Hospitalier Universitaire de Butare

CHUK: Centre Hospitalier Universitaire de Kigali

CI: Confidence Interval

CMHS: College of Medicine and Health Sciences

Corp.: Corporate

IBM: International Business Machines

ICU: Intensive Care Unit

IQR: Inter-quartile range

MEOWS: Modified Early Obstetric Warning Score

NY: New York

OR: Odd ratio

p-value: calculated Probability

qSOFA: Quick Sequential Organ Failure Assessment

Ref: Reference

ROC: Receiver Operating Characteristic curve

SAPS: Simplified Acute Physiology Score

SCCM: Society of Critical Care Medicine

SD: Standard deviation

SOFA: Sequential Organ Failure Assessment

SPSS: Statistical Package for Social Sciences

Declarations

Ethics approval and consent to participate

The study was approved by ethical and scientific committee of the University of Rwanda College of Medicine and Health Sciences (CMHS) [approval notice No 118 /CMHS IRB/2017]. The individual consent for participation was waived given the minimal risk to the patients.

Consent for publication

Not applicable. The manuscript does not contain individuals' personal data.

Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

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Competing interests

No competing interests are declared.

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Authors' contributions

AR: Study design, data analysis, interpretation and manuscript writing.

TT: Data analysis, interpretation and manuscript writing.

ALC: Study design and manuscript writing.

All authors have read and approved the final manuscript.

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Figures

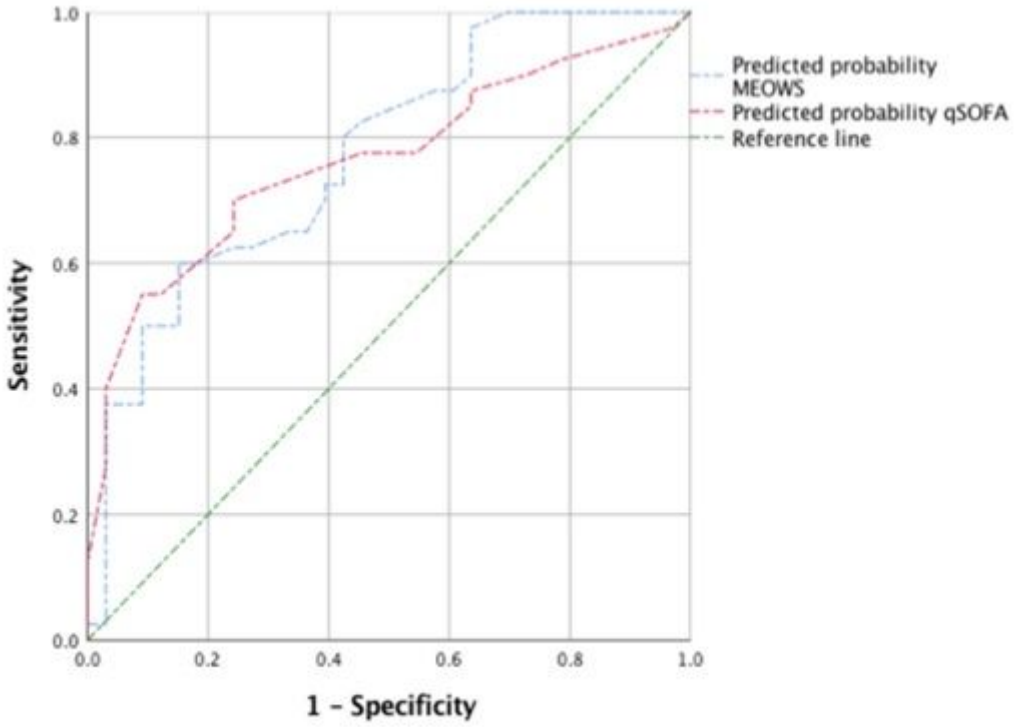

Figure 1

AUROC for prediction of mortality by MEOWS and qSOFA