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Original Research Article

Obstetric Patients Requiring Intensive Care: Prevalence, Clinical Characteristics and Outcome in a Tertiary Care Institute in Nigeria

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Abstract: Maternal mortality is a major health problem in developing countries. Critical care of the obstetric patient has been recognized as a useful tool in the reduction of maternal morbidity and mortality. The study is a five year retrospective review of the clinical characteristics and outcome of all obstetric admissions into the ICU. Data collected and analyzed included demographics, diagnosis at admission, mode of delivery, ante natal booking status, duration of admission into the ICU, mechanical ventilatory support, duration of stay on the ventilator and outcome of ICU admission. There were 170 obstetric admissions accounting for 25.3% of total ICU admissions during the period of review. The mean age of patients was 30.2±29.2 years. Hypertensive disorders of pregnancy accounted for the highest cause of obstetric admission diagnosis 51.7%. Majority of the patients 94.7% were admitted postpartum. The mean length of ICU stay was 2.7 ± 2.8days. Mortality was 26.5% with a significantly higher percentage of deaths in unbooked/referred patients (66.7%). There is a high rate of ICU admission of obstetric patients in our hospital. Mortality is also high especially among unbooked late referrals. Timely referrals and early recourse to ICU care by booked patients may provide some improvement in the standard of care received in the ICU with a subsequent lower mortality.

Keywords: Intensive Care Unit, Critical care, Obstetric patients, Hypertensive disorders, Obstetric haemorrhage, Maternal Mortality.

INTRODUCTION

Critical care is a bonafide part of obstetric practice (Bhadade, De'Souza & Harde, 2012). A critically ill obstetric patient is one who, because of normal or abnormal pregnancy, delivery, and puerperium, or because of the effects of systemic disease, develops complications that threaten her life for which she needs intensive monitoring, therapy or life support system (Bhadade *et al.*, 2012). The physiologic burden of pregnancy places the pregnant patient at a greater risk of contracting and developing emerging infections, thromboembolic accidents, sepsis and other diseases (Kaur, Singh & Trikha, 2017). For the majority of women, pregnancy and labour progress without any event as patients are usually young and healthy with minimum or no co-morbidity. However for an estimated few, the reverse is the case. About 600,000 women worldwide die annually from complications related to pregnancy or childbirth and ninety-nine percent of these deaths occur in developing countries (Bhadade *et al*,

2012). A woman's lifetime risk of dying from pregnancy-related complications or during child birth is 1 in 48 in developing countries like Nigeria, as against 1 in 1800 in developed countries (Bhadade *et al*, 2012). Although obstetric patients are young and healthy, the maternal mortality ratio reported from intensive care units in developed countries is around 21 per 10,000 deliveries (Leung, Lau, Chan & Yan, 2010; Muhammad, Muhammad & Ibrahim, 2010). In developing countries like Nigeria figures as high as 47.6% and 52% have been reported (Muhammad *et al.*, 2010).

In Hong Kong, the maternal mortality ratio decreased from 125 per million births in 1946 to 3.5 per million births in 2005. Factors related to the change include, improved socio-economic conditions, availability of comprehensive antenatal, obstetric, anaesthetic and intensive care services, as well as

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access to more advanced treatment modalities (Osinaike, Amanor-Boadu & Sanusi, 2006).

About 72% of maternal deaths can be prevented through effective antenatal care. However, as most obstetric emergencies are not predictable and 15% of all pregnant women develop life-threatening complications, antenatal care will not prevent all the maternal deaths. The combination of antenatal and intensive obstetric care is essential for reducing maternal mortality (Bhadade *et al.*, 2012). Critical care for the obstetric patient has also been recognized as a useful tool in the reduction of maternal morbidity and mortality (Osinaike *et al.*, 2006).

Maternal mortality and morbidity are important quality-assurance indicators (Osinaike *et al.*, 2006; Tobi & Osaikhuwuomwan, 2014). There is paucity of well-defined guidelines for the management of critically ill obstetric patients; most of the ICU physicians apply general critical care principles for the care of these parturients. When faced with the clinical situation of a deteriorating parturient maternal well-being is the priority (Kaur *et al.*, 2017).

MATERIAL AND METHODS

This was a retrospective, observational study of all parturient and 42-day postpartum patients admitted to the ICU between January 1, 2014, and December 31, 2018.The ICU at the University of Abuja Teaching Hospital Gwagwalada, Nigeria is a four bedded multidisciplinary adult and paediatric ICU. Patients were managed by an ICU team, consisting of 4 Anaesthesiology Consultants, Anaesthesiology residents, and Critical Care trained Nurses. The admitting and referring obstetric unit provided consultation on a daily basis. The case notes and ICU admission and discharge records of all the obstetric patients admitted to the ICU during the study period were reviewed and data collected included basic demographics, obstetric/medical history and diagnosis at admission, ICU course and length of stay, treatment given, mechanical ventilatory support and duration of stay on the ventilator. In addition the clinical condition that prompted ICU admission (organ failures as defined in Table 4) and outcome of ICU admission (discharged out alive or dead) were also recorded. The disease process identified to be responsible for the patient's critical illness was referred to as the primary diagnosis and was categorized as obstetric or non-obstetric. Obstetric cases were defined as patients whose admission were directly related to pregnancy or puerperal state while non-obstetric was considered as critical illness resulting from other medical conditions coinciding with pregnancy or puerperium. The data collection protocol was approved by the Institutional Ethics Review Board of the University of Abuja Teaching Hospital.

Data obtained were analyzed using SPSS window version 24. Continuous data are expressed as the mean and standard deviation (SD) and were compared using the student t test. Categorical data are expressed as numbers and percentages and compared using the chi-square test. A univariate analysis was performed to examine the association of age, length of ICU stay, ICU admission diagnosis, mode of delivery, mode of admission, time of admission to ICU, mechanical ventilatory support. Statistical significance was defined as a *P* value less than 0.05. Result is summarized and presented using tables and figures as appropriate.

RESULTS

The hospital records of 170 obstetric patients out of a total of 671 patients admitted into the ICU during a 5 year study period were extracted and reviewed. There were 8970 live births during the study period giving an ICU admission rate of 19/1000 live births in the hospital and ICU utilization ratio of 1.9%. Obstetric patients constituted 25.3% (170/671) of the total admission with an age range of 16-46years and mean of 30.2±29.2 years. The mean length of ICU stay was 2.7±2.8.days (Table1). Other baseline characteristics of the patients at admission are shown in Table 1. Most of the patients 94.7% (161/170) were admitted in the postpartum period. Seventy seven patients 47.2% (77/170) were registered (booked) in the hospital while 50.6% (86/170) of the patients were referred (unbooked) to the University of Abuja Teaching Hospital following failed management in other secondary general or private hospitals and because of their high-risk status. Table 2 shows that 98.8% (168/170) of the admissions were for obstetric reasons while only 1.2% (2/170) were for non-obstetric reasons. Hypertensive disorders of pregnancy accounted for the highest cause of obstetric admission diagnosis 52.4% (89/170) out of which Ecclamptic disorders 55% (49/89) was the most common followed by Preeclamptic hypertensive disorders (Table 2). Obstetric haemorrhage was the second leading cause of ICU admission. It accounted for 42.9% (73/170) of the obstetric admissions with 53.4% (39/73) being due to post caesarean section post- partum haemorrhage. Table 3 shows that majority of the patients 96.6% (164/170) had surgery and thus were admitted directly from the operating theatre. Of these operated patients 89.4% (152/170) were post caesarean section. While 76.3% (116/152) were post emergency caesarean section, 23.7% (36/152) were post elective caesarean section. Three patients 1.8% (3/170) were admitted following surgery for ectopic gestation and subsequent intraoperative cardiac arrest and haemodymic instability. Four patients were admitted following septic abortion (Table3). Eight patients (4.6%) had intraoperative complications that were directly due to anaesthesia resulting in ICU admission; Two patients had intraoperative cardiac arrest and were successfully resuscitated, one patient had anaphylactic reaction to

one of the agents used in the cause of the anaesthesia during an elective caesarean section while one patient with a huge thyroid (anterior neck mass) had difficult intubation during induction of general anaesthesia for foetal distress. She was admitted to the ICU with the endotracheal tube left in-situ for 72hours for fear of tracheomalacia. She was subsequently successfully extubated. Haemodynamic instability and Neurologic impairment were the two most common organ impairments that were directly responsible for ICU admission, 34.1% (58/170) and 23.5% (40/170) respectively. Table4. Table 5 shows that only three main types of special intervention were offered to patients: ventilatory support, inotropic support and central venous catheterization. Forty six patients 27.1% (46/170) had mechanical ventilatory support and this was the most common intervention, while 11.2%

(19/170) had inotropic support. Patients who had hypertensive disorders of pregnancy made up fifty seven percents (57%, 26/46) of the ventilated patients with ecclamptic patients making up 69.2% (18/26) of this number. This was followed by patients who had antepartum haemorrhage 19.6% (9/46). Forty one percent (19/46) of the patients whose lungs were mechanically ventilated in our study died. (Table5). Mortality for these obstetric patients was 26.5% (45/170). This represented 20.9% of total ICU death during the period of study Table 6. Major contributors to mortality in this study were sepsis (100), ruptured ectopic (66.7%), Mechanical ventilatory support (47.8%), ICU stay $\geq$ 7days (37.5%), Unbooked antenatal status/referral (34.9%). Of the 45 deaths, 30 (66.7%) were unbooked and referred patients from other health institutions.

Table 1: Patient Characteristics

AGE DISTRIBUTION(years)	FREQUENCY	%
<20	6	3.5
20-29	69	40.6
30-39	80	47.1
40-49	15	8.8
Total	**170**	**100**
Mean Age	30.2±29.3	
Range	15-45	
BOOKING STATUS		
Registered (booked in hospital)	77	47.2
Referredl(unbooked)	86	50.6
MODE OF DELIVERY		
Virginal Delivery	8	4.8
Instrument Delivery	1	0.6
Elective Caesarean Section	36	21.4
Emergency Caesarean Section	116	69.0
Abortion/Ectopic	7	4.2
OPERATED		
Operated	164	96.6
Not Operated	6	3.4
TIME OF ADMISSION		
Antepartum	2	1.2
Postpartum	161	94.7
Post Abortal/Ectopic	7	4.1
LENGTH OF STAY IN ICU		
<7 days	157	92.0
≥7days	13	8.0
Mean length of stay	2.7± 3.1	
Range	0-15	

Table 2: ICU Admission Diagnosis and Outcome

ICU ADMISSION DIAGNOSIS	FREQ.	PERCENTAGE (%)		
Obstetric	168	98.8		
Non-Obstetric	2	1.2		
NON OBSTETRICS ICU ADMISSION DIAGNOSIS			FREQ.	PERCENTAGE (%)
NA			168	98.8
Congestive cardiac failure			1	0.6
IVF with Gestational diabetes and PIH			1	0.6
OBSTETRIC ADMISSION DIAGNOSIS	TRANSFER	DEATH	TOTAL	
Antepartum Hemorrhage	16 (12.5)	7 (15.2)	23 (13.2)	
Post Caesarean Section Postpartum Hemorrhage	29 (22.7)	10 (21.7)	39 (22.4)	

Post Virginal Delivery Postpartum Hemorrhage	6 (4.7)	2(4.3)	8(4.6)
Ruptured Ectopic	1(0.8)	2(4.3)	3(1.7)
Pre Eclampsia hypertensive disorders	29 (22.7)	6 (13.0)	35 (20.1)
Eclampsia Hypertensive disorder	35(27.3)	14 (30.4)	49 (28.2)
HELLP Syndrome Hypertensive disorder	5 (3.9)	0	5 (2.9)
Septic abortion	2 (1.6)	2 (4.3)	4 (2.3)
Anaesthesia complication	5 (3.9)	3 (6.5)	8 (4.6)

Table 3: Obstetric admission diagnosis and Type of Operation

Obstetric Admission	Emergency CS	Elective CS
Antepartum Hemorrhage	14	9
Post Caesarean Section	23	16
Post-partum Hemorrhage		
Post Virginal Delivery	0	0
Postpartum Hermorrhage		
Ruptured Ectopic	0	0
Pre-Eclampsia hypertensive disorders	25	9
Eclampsia Hypertensive disorder	45	0
HELLP Syndrome		
Hypertensive disorder	5	0
Septic abortion	0	0
Anesthetic complication	4	2
Type of Operation	**Freq**	**percentage (%)**
Elective Caesarean section	36	21.2
Emergency caesarean section	116	68.2
Laparotomy for rupture ectopic gestation	3	1.8
Laparotomy for post abortal sepsis	4	2.4
Repair of cervical laceration (post Virginal Delivery)	3	1.8
Repair of cervical laceration post instrumental delivery	2	1.2

Table 4: Admission Diagnosis Organ Impairment

INTERVENTIONS	FREQ.	PERCENTAGE (%)		
NA	51	30		
Respiratory Failure	18	10.6		
Hemodynamic Instability	58	34.1		
Neurologic Impairment	40	23.5		
Renal Impairment	3	1.8		

	NA	Respiratory Failure	Haemodynamic Instability	Neurologic Impairment	Renal Impairment
Obstetric admission					
Antepartum Hemorrhage	1	0	9	0	0
Post Caesarean Section postpartum Hemorrhage	7	10	16	3	3
Post Virginal Delivery Postpartum Hemorrhage	3	0	3	2	0
Ruptured Ectopic	1	0	2	0	0
Pre-Eclampsia hypertensive disorders	11	2	11	11	0
Eclampsia Hypertensive Disorder	11	5	15	18	0
HELLP Syndrome Hypertensive disorder	4	0	0	0	1

Septic abortion	0	1	2	1	0
Anaesthesia complication	4	0	0	4	0
Non-obstetrics ICU admission diagnosis					
congestive cardiac failure	1	0	0	0	0
IVF with Gestational diabetes And PIH	1	0	0	0	0

Table 5: Intervention in the Icu

INTERVENTION	OUTCOME		Total
	transfer to the ward	Death	
mechanical Ventilation	24	22	46
Inotropic support	12	7	19
Central Venous Catheter	1	0	1
Nil			
ICU Admission diagnosis and Mechanical ventilation	**Freq.**	**Percentage (%)**	
Antepartum Hemorrhage	9	19.6	
Post Caesarean Section Postpartum Hemorrhage	5	10.9	
Post Virginal Delivery Postpartum Hemorrhage	2	4.3	
Ruptured Ectopic	1	2.2	
Pre Eclampsia hypertensive disorders	7	15.2	
Eclampsia Hypertensive disorder	18	39.1	
HELLP Syndrome Hypertensive disorder	1	2.2	
Septic abortion	1	2.2	
Anaesthesia complication	2	3.3	
Total	**46**	**100**	
Outcome from mechanical ventilation			
Transferred to the ward	27	58.7	
Death	19	41.3	
Total	**46**	**100**	

Table 6: Contributors to Mortality

Factors	No of Cases	No of Death	Ratio of Death to cases	% Death
Mechanical Ventilation	46	22	22/46	47.8
Unbooked/Referral	86	30	30/86	34.9
Booked	77	15	15/77	19.5
Antepartum Haemoorhage	23	7	7/23	30.4
Post CS postPartum Haemorrhage	39	10	10/39	25.6
Post Virginal Delivery Postpartum	8	2	2/8	25
Ruptured Ectopic	3	2	2/3	66.7
Pre-eclampsia	35	6	6/35	17.1
Eclampsia	49	14	14/49	28.6
Septic Abortion	4	4	4/4	100
Anaesthesia complication	8	2	2/8	25
Emergency CS	116	30	30/116	25.9
Elective CS	36	8	8/36	22.2
ICU stay <7 days	154	39	39/154	25.3
ICU ≥7days	16	6	6/16	37.5

Table 7: Outcome of Length of Days in ICU

DAYS TOTAL	TRANSFER	DEATH	OUTCOME
1day	54	21	75
2days	31	7	38
3days	14	5	19
4days	10	3	13
5days	4	1	5
6days	2	2	4
7days	2	1	3
8days	2	1	3
9days	2	0	2
10days	1	1	2
11days	1	1	2
13days	1	1	2
14days	1	0	1
15days	0	1	1
TOTAL	125	45	170

DISCUSSION

Obstetric medicine is different from general medicine because of the various physiologic changes occurring in pregnancy, and only an experienced obstetrician who has good knowledge of obstetric medicine can interpret and understand complex conditions in pregnancy. Though most women do pass through pregnancy uneventfully, a certain proportion will develop complications that would require ICU admission.

This study demonstrates that obstetric subjects account for a substantial proportion (25.3%) of ICU admissions in our tertiary referral centre, and this is consistent with reports from other Low middle income countries (Embu, Isamade,Nuhu, Oyebode &Kahansim, 2016; Abdullahi, Aliyu & Adamu, 2012). Intensive care unit admission rates for obstetric patients have been found to differ between developed and developing nations with lower rates in developed nations (Embu *et al.*, 2016). While obstetric ICU admissions in developed countries are in the region of 0.1 – 0.9%, in developing countries rates of up to 10% have been reported with studies from Nigeria reporting obstetric admission rates of 1.5% to 7.27% (Bajwa & Bajwa, 2012; Leung *et al.*, 2010; Embu *et al.*, 2016). The rate of 25.3% seen in this study though very high is similar to that of Embu *et al.*, (2016) from a general intensive care in North Central Nigeria. Obstetric critical care has not been able to achieve the same level of peaks in developing nations like India and Nigeria, as in western countries where there is a wide gap in the quality of care. This wide gap to a large extent is attributable to the lower literacy rates, paucity of research in obstetrical critical care, poverty, lack of awareness, and the sociocultural and behavioral factors prevalent in these developing nations (Bajwa & Bajwa, 2012). The low rates from studies from developed countries are indicative of the fact that obstetric care at peripheral referring hospitals is much improved compared with that in developing countries (Tobi *et al.*, 2014). The high rate seen in our study is also a reflection of the high frequency of complications that are associated with pregnancy in our setting. There is poor utilization of antenatal care with the result that a large population of women go through pregnancy unsupervised. Inadequate access to antenatal care would also mean that a large number of obstetric patients present to hospital with complications and this increases the need for intensive care in these patients.

Threshold for ICU admission differ between hospitals and our finding may be a reflection of a low threshold in our hospital. The high ICU admission rate may also be as a result of absence of an HDU in our facility which is also common with most tertiary hospitals in our environment. Developing obstetric HDUs and better equipping our delivery rooms will reduce ICU admission rates. On the other hand having well equipped labour rooms and high quality of obstetric services obtainable in developed countries may be a factor for low ICU admission rates seen in developed countries (Embu *et al.*, 2016).

Majority of the patients in this study were young women in their thirties with a mean age of 30.2±29.2. Similar mean age at admission has been recorded in the literature (Leung et al, 2010; Lapinsky, Kruczynski, Seawardt, Farine, & Grossman, 1997) as well as lower mean ages (Muhammad *et al.*, 2010; Osinaike *et al.*, 2006; Joseph, Bhatia &Abraham, 2018; Gupta, Naithani, Bhargava & Bhavani, 2011). In our study, 69 patients were between the ages of 20 and 29 years (40.0%), and 95 (55.9%) of the patients were over age 30years. This is unlike the studies by Bhadade *et al.,* (2012) and Rochat *et al.,* (1988) that showed that the majority of the obstetric patients requiring critical care are in the age group of 21–30 years. The higher age at ICU admission seen in our study may not be unconnected with the fact that in recent times the number of older women giving birth has increased worldwide. Reasons adduced for this increase include delay in marriage, prolonged education, education and career priority, effective birth control, delayed

conception due to infertility, desire for large family, longer life expectancy, heavy working conditions and advances in assisted reproductive technology (Orazulike, Jeremiah, Green & Uzoigwe, 2015). In addition, contrary to what obtains in developed countries where advanced maternal age women are more often primiparous, childbearing at advanced maternal age is more common among multiparous women in developing countries as Nigeria as a result of factors such as lack or ineffective family planning methods, favorable cultural disposition towards large family sizes, poverty and economic problems (Orazuike *et al.*, 2015).

In our series, the mean duration of ICU stay was 2.7 ± 2.8 days. The length of ICU stay in our patients was similar to that seen in other studies from Nigeria (Joseph *et al.*, 2018; Okafor, Efetie & Amucheazi, 2011) and from, Saudi Arabia, America and Europe (Embu *et al.*, 2016; Mirgham, Hamed & Ezimokhai, 2004).This mean period of stay in ICU in this study was shorter than that reported from Mohammad *et al.*, (2010) from Kano but longer than 1.6±1.5 days and 2.6±2.1 days reported from the United Arab Emirate and Ibadan, Nigeria respectively (Osinake *et al.*, 2006; Tang, Kwok, Wong, Lee, & So, 1997). Ninety percent (90%) of the patients in this study spent less than 7 days in the ICU. This is similar to 4.1 days reported in the Tang *et al.*, (1997) study and 5 days in the Rakesh *et al.*, study (Bhadade *et al.*, 2012). Fifty four patients spent less than 24hrs in the ICU (Table 7). This could be attributed to the fact that most obstetric patients are young and free of comorbidities and the reason for ICU admission most often has to do with complications of pregnancy. Once these complications are treated, they will most likely be discharged to the ward. This could be responsible for the short duration of stay in the ICU. The observed short stay of these patients translates to a better and more favourable cost effectiveness of admission of obstetric patients in the ICU. In addition, these patients are spared the common complications of prolonged ICU stay (Osinaike *et al.*, 2006). Unlike in our study, in the study by Basket *et al.*, (1998), the average duration of critical care required in majority of the patients (72%) was around 8–10 days. In our study the survival rate was highest in the first four days of admission (65.0%) while mortality rate was highest within the first 24 hours after admission 47% (21/45) with patients referred or transferred very late from other hospitals in moribund condition having poor prognosis. The poor condition of these patients on arrival in our facility may have contributed to this early death in ICU. This highlights the fact that more patients can be made to survive if patients are referred early. The first 24hrs is a very critical time in the management of these patients as these patients need more intense care to improve mortality. Patients in critical state should therefore be treated at the earliest possible time as a good ICU care with monitoring can save a young productive life.

Hypertensive disorders of pregnancy accounted for the highest cause of obstetric admission diagnosis 51.7%. This is similar to several other studies which showed that pre-eclampsia/eclampsia was the predominant indication for admission to their ICUs (Mirgham *et al.*, 2004; Faponle & Adenekan, 2011; Osinaike *et al.*, 2006; Muhammad *et al.*, 2010; Joseph *et al.*, 2018). Our report contrasts with that of Leung *et al.*, (2010) that indicated that Pregnancy-related hypertensive disorders were the second commonest obstetric cause of admission. Pre-eclampsia and eclampsia are major causes of maternal morbidity and mortality worldwide, especially in developing countries (Leung *et al.*, 2006). It is therefore not surprising that eclampsia accounted for 51.7% of all obstetric cases admitted into the ICU. In the study by OKafor and Efetie (2011) obstetric hemorrhage was the predominant diagnosis for admission to the ICUs. In the study by Leung *et al.*, (2010), pregnancy-related hypertensive disorders were the second commonest obstetric cause of admission. The higher percentage of pregnancy-induced hypertension seen in our study is probably as a result of the fact that our institution though located in the Federal Capital Territory is a tertiary institution and a referral centre and thus receives majority of the complicated obstetric cases in the immediate environ. In particular it serves mainly the indigent population. Fifty one percent of the obstetric patients admitted into the ICU did not have their antenatal care in our facility but were referred to our facility for more expert care and management. It is not known if these patients had any form of antenatal care. Many studies indicate that the most common reasons for ICU admission for obstetric patients are hypertensive disorders and massive obstetric haemorrhage (Guptha, *et al.*, 2011; Ntuli, Ogunbanjo, Nesengani & Mboya, 2015; Green & Orazulike, 2018).

In this index study Obstetric haemorrhage was the second leading cause of ICU admission. It accounted for 36.5% (62/170) of the obstetric admissions. Our findings contrast with majority of reports by other studies that indicate that obstetric haemorrhage is the major cause for ICU admission (Guptha *et al.*, 2011). In the study by Gupta *et al*, (2011) it represented the main cause for ICU admission (62.5%). Obstetric haemorrhage as the second most common reason for admission in to our ICU consistent with the report by Osinaike *et al*, (2016). Post caesarean section postpartum haemorrhage accounted for 63% of the cases of obstetric haemorrhage in this study. Excessive haemorrhage associated with caesarean section, commonly defined as blood loss in excess of 1000 ml, is frequently underestimated, but is documented as occurring in more than 5-10% of caesarean sections. It is a major cause of maternal morbidity globally and of maternal mortality in low- and middle-income countries (Fawcus & Moodley, 2013). Severe hemorrhage may also result as a complication primarily due to the procedure, cesarean

delivery. Excessive blood loss can be intra-operative, but may also occur postoperatively through vaginal bleeding or concealed intra-peritoneal bleeding. The latter is frequently unrecognized by attending health workers. Previous retained placenta, blood disorders, antepartum transfusion, preterm birth and general anaesthesia have been found to be risk factors for PPH after emergency caesarean section while Leiomyomata, placenta praevia, antepartum bleeding, preterm birth and general anaesthesia are risk factors for PPH after elective caesarean section (Fawcus & Moodley, 2013). Clinical practice, knowledge of risk factors for caesarean section PPH enables adequate planning for level of care, availability of blood products, and availability of skilled surgical assistance. Caesarean delivery being a high risk factor for post-partum haemorrhage, correcting anaemia before delivery and the availability of a functional blood banking facility may go a long way in reducing the morbidities from post caesarean section post-partum haemorrhage (Chama, Mairiga, Geidam & Bako, 2010). Public enlightenment and campaign to encourage the general public to imbibe the culture of voluntary blood donation will keep our blood banks viable and make blood readily available during emergencies. This may in turn reduce morbidities from post- partum haemorrhage and the need for ICU care (Chama *et al,* 2010).

Operative delivery accounted for a significant number 96.6% of the cases admitted into the ICU with emergency Caesarean section being responsible for 76.3% of this. The finding from this study is consistent with the study by Green *et al,* (2018) where most of the obstetric admissions to their ICU occurred following emergency Caesarean delivery. The high percentage seen in this study is similar to that by Neto *et al,* (Green & Orazuike, 2018) 78.5% but lower than that by Osinaike *et al,* (2006) 85% and Tobi and Osaikhuwuomwan (2014) 92% from Nigeria while other studies report a lower percentage of Cesarean section among ICU patients, 50.7%, 52.9 %, and 67.27 % respectively compared to this study (Green & Orazulike, 2018; Zwart, Dupuis, Richters, Ory & Roosmalen, 2010). The high rate of CS in our study could be due to the fact that our hospital serves as a referral center for other hospitals, clinics and maternity homes and thus may receive complicated pregnancies or women who are referred because they may need CS.

Cesarean delivery, especially in the presence of obstetric and medical comorbidities can be a potential risk factor for ICU admission. In a case control study which examined the risk factors for ICU admission during delivery in the US, women who had CS were about 9 times more likely to be admitted into the ICU than those who had vaginal delivery. (OR=9.0, 95%CI=7.24 to 11.16) (Osinaike *et al,* 2006). It has also been reported that 10% of women who had CS would require special care in the postoperative period in a high dependency unit (HDU), 3.5% of which would be

eventually transferred to the ICU (Osinaike *et al*, 2006). In the study by Zwart *et al,* (2010) that analysed risk factors for obstetric ICU admission, Emergency caesarean delivery was found to be an adjusted risk factor for ICU admission. Overall, Cesarean delivery is commonly considered an extremely safe operation especially when done as an elective procedure. The high relative risk of ICU admission among women who delivered by Caesarean is probably confounded as Caesarean delivery could be the consequence of the underlying disease for which the mother was admitted rather than the risk factor. It can thus be assumed that most of the serious complications associated with cesarean deliveries may not be due to the operation itself but rather due to the reason for the cesarean delivery as seen in the study by Mohammad *et al,* (2010) where pregnancy induced hypertension was among the top six indicators for Caesarean section. In this index study 55.3% of patients who had Caesarean section and 64.7% of patients who had emergency Caesarean section had coexisting hypertensive disorders of pregnancy. Complications of haemorrhage contributed to 12.1% of emergency CS and 15% of total CS. On the other hand complications that can be directly attributed to the caesarean delivery (post caesarean section post-partum haemorrhage and complications due to anaesthesia were seen in only 31% of patients who had caesarean delivery thus indicating that the indications for caesarean section may be a higher potential risk factor for ICU admission rather than the effect of the CS.

Majority of the patients in our study were admitted in the postpartum period. This is consistent with findings from studies in Nigeria and similar findings from a study in Bangalore, India (Faponle *et al,* 2010*;* Green & Orazulike, 2018). The third trimester as well as the postpartum period have been identified as the most common time of admission with conditions such as severe pre-eclampsia, eclampsia, HELLP syndrome (Haemolysis, elevated liver enzymes, low platelet count), antepartum haemorrhage, postpartum haemorrhage and anaemia being the most common indications for admission (Bhadade *et al*, 2012; Joseph *et al,* 2018; Green & Orazulike, 2018). A major contributory factor for this high incidence of postpartum admission in our study is the fact that most of the patients were referred to our centre in very bad state. They thus required immediate surgical intervention to save either the mother or baby in the form of Caesarean section and subsequently developed complications that required organ support. For most of them there was little room for other intervention after resuscitation save surgical intervention. Tertiary referral centres like ours are known to usually admit more high-risk obstetric patients (Ntuli *et al*, 2015).

Seventy seven (45.3%) of the patients admitted had their antenatal care in our hospital while 50.6% were referred to our facility for more expert care from

smaller peripheral hospitals. This is similar to reports from other studies (Faponle & Adenekan, 2011; Green & Orazulike, 2018). Our finding is low compared to that in the study by Shaheena *et al,* (2015) where majority of the women (93.68%) who needed admission to the ICU were not booked at their hospital mainly because most the women had an antenatal diagnosis of Placenta praevia and had chosen to get antenatal care at a tertiary care facility. The study by Green and Orazulike (2018) found a statistically significant association between a lack of antenatal care and admission of obstetric patients into the ICU (Green & Orazulike, 2018). In the study by Verma (2014) it was observed that unbooked women have more complications resulting in increased need for ICU care and in the study by Osinaike *et al,* (2006), poor antenatal care was found to have a considerable effect on obstetric complications and outcome (Osinaike *et al*, 2006). Ante natal clinic registration and attendance confers significant protection in critical illness in pregnancy. This fact was ascertained by a study done by Karnad *et al*., (2004) in which lack of prenatal care and delay in ICU referral proved to adversely affect the outcome in critically ill pregnant females (Karnad *et al*., 2004). However unlike in other studies the lack of antenatal care has not been found to be a risk factor for ICU admissions (Lapinsky *et al*, 1997; Osinaike *et al*, 2006; Guptha *et al*, 2011). Unbooked status is also significantly associated with maternal death. A major contributory factor being the lack of peripheral connectivity and inadequate primary, secondary and tertiary referral system that leads to loss of precious time in management of the critically ill pregnant patient and a key factor responsible for maternal mortality. Regular prenatal care of patients and timely detection of risk factors and prenatal intervention helps to improve maternal prognosis significantly. In the study by Lin Lin *et al*, (2019), admission by referral (OR=7.347) and no prenatal care (OR=3.145) were found to be among the 15 factors with a significant independent risk for admission into the ICU (Lin Lin *et al,* 2019).

The requirement for ventilatory assistance is among the most frequent reasons for intensive care unit (ICU) admission. Forty six patients 27.1% received invasive mechanical ventilation for complications such as pulmonary oedema, aspiration pneumonitis, recurrent convulsions in the eclamptic patients and for neurological involvement and circulatory shock. In comparison, the percentage of the obstetric patients requiring mechanical ventilation in the ICU has been reported as 19% by Selo-Ojeme *et al,* (2010) 41% by Cohen *et al,* (2010) and 64% by Tripathi *et al,* (2000). The percentage of patients who received ventilatory support in our study is higher than values from previous studies (Tobi & Osiakhuwuomwan, 2014; Osinaike *et al*, 2006; Dunser, Towey, Amito & Mer, 2017) but much lower than the rates of 45% to 70. 8% reported from elsewhere (Muhammad *et al,* 2010; Okafor *et al,* 2011; Lapinsky *et al*, 1997; Tang *et al*, 1997; Toga *et*

al, 2010). The indications and duration of ventilation detailed in these studies were also similar to ours. Patients who had hypertensive disorders of pregnancy made up fifty four percent (54%) of the ventilated patients with ecclamptic patients making up 72% of this number. This was followed by patients who had antepartum haemorrhage 19.6%. In the Guptha *et al,* (2011) study, the need for ventilatory support was a major indication for ICU admissions among antenatal patients with pregnancy-induced hypertensive disorders (n=3/4, 75%). In the Dunser *et al,* (2017) study, mechanical ventilation was offered to only, a selected proportion of patients with severe traumatic brain injury, burns or neonatal tetanus while patients with either a high mortality risk, or a low chance of a good functional outcome were excluded. This is unlike our centre where everyone who needed mechanical ventilation was offered as long as there was a free and available ventilator. However in a developing economy as ours, often times patients that require ventilatory support do not get it either because of unavailability of ventilators or inability to afford the cost of ICU care (Osinaike *et al*, 2006). Ventilator therapy in developing countries like ours is observed to be associated with very high mortality rates (58%-74%) except for mechanical ventilation in the immediate post-operative period (Faponle & Adenekan, 2011).

Report from studies from developed, developing and underdeveloped countries indicate that there is a wide variation in the mortality rates of obstetric patients admitted to the ICU. Maternal mortality in the ICU is increasingly rare in developed countries where some studies have reported zero maternal death (Ntuli *et al*, 2015). The mortality rate for the obstetric patients admitted into the ICU in this study was 26.5%. The mortality rate in this study is similar to that seen in earlier studies from North Western Nigeria by Adamu *et al,* (2014) and Muhammad *et al,* (2010) that reported mortality rates of 25.61% and 26.7% respectively. This is however lower than the 28% reported by Okafor and Efetie (2008), 33.3% by Okafor *et al,* (2011) from Enugu, Southeast Nigeria, 50% and 60% reported by Osinaike *et al,* (2006) and Dao *et al,* respectively (Muhammad *et al*, 2010; Abubakar *et al*, 2014). This mortality rate is high compared to other studies from the developed world and Asia. Leung *et al,* (2010) from a developed country reported a rate of 6% (Leung *et al, 2010;* Muhammad *et al*, 2010). from the United States, Collop and Sahn of 20% and *Jenkins et al* 14% while Cheng *et al* reported a case fatality rate of 4.6% in their study in Singapore (Muhammad *et al*, 2010; Okafor *et al*, 2011). High utilization of ICU facilities by obstetric patients of low socio-economic class and the high number of unbooked and referred patients from other facilities in advanced stages of disease as seen in our centre can contribute significantly to the high mortality of obstetric patients admitted into the ICU. Thus early recourse to ICU care by booked patients who have been under the care of obstetricians

may provide some improvement in the standard of care received in the ICU with a subsequent lower mortality (Muhammad *et al*, 2010). In the study by Green and Orazulike (2018) from Port Harcourt, in South South Nigeria mortality was noted to be higher among unbooked patients than booked patients (Green & Orazulike, 2018). This is similar to the finding in this study where unbooked mothers accounted for 66.7% of deaths compared to booked mothers. In the study by Shaheena *et al,* (2015) unbooked status and late referrals from peripheral hospitals were major contributors to the recorded ICU maternal mortality. Among the women who died in their study, majority (93.33%, n=28) where referred from peripheral hospitals (Shaheena *et al,* 2015). The disparity in the ICU maternal mortality rate between booked and unbooked/referred patients highlights the importance of antenatal care as an important tool in the prevention of maternal morbidity and mortality. It also underscores the importance of booking for antenatal care, prompt presentation at the hospital during emergencies, availability of skilled birth attendants, and provision of adequate facilities for the management of critical obstetric cases. Although not statistically significant, complications of preeclampsia and eclampsia, Post Caesarean section postpartum and antepartum haemorrhage were important causes of death in our study. This is similar to the reports of Adeniran *et al,* (2015) and Okafor *et al,* (2008) where these diagnoses featured prominently among the causes of death among critically ill obstetric patients (Okafor *et al,* 2008; Adeniran *et al*, 2015)). Other possible reasons for the high maternal mortality rate in our study are late referrals, poor transport facilities, limited specialist obstetrician and critical care specialist support, long distances to the referral hospital and inadequate emergency obstetric care at referral centres close to patient residences. Mortality can be reduced with better equipping of the ICU and regular training of personnel in the management of the critical obstetrics patient. Other measures that can help to reduce maternal mortality include ensuring easier accessibility and comprehensiveness of obstetric care, especially in the less connected regions and provision of adequately stocked blood banks in peripheral health centres. One important area that needs urgent attention is lack of adequately stocked blood banks in peripheral health centres. The study by Cruz (2007) found an inverse association between donor blood availability and both maternal mortality ratios and risk of death due to postpartum haemorrhage (Cruz, 2006). In addition, having a dedicated obstetric ICU in tertiary hospitals can ensure that there is no delay in patient management and that intensive care can be instituted at the earliest.

Similar to the study by Embu *et al,* (2016) and Gupta *et al,* (2011) we found the most common primary indication for admission into the ICU to be cardiovascular instability. This is unlike in the study by Faponle and Adeneken (2011) and Osinaike *et al,* (2006) where the most common reason for admission into the ICU was neurological dysfunction in the study by Faponle and Adeneken (2011) while respiratory failure was the predominant indication for ICU admission as found by Osinaike *et al,* (2006).

CONCLUSION

There is a high utilization of intensive care with majority of the women being young and between the ages of 29-40years of age. Hypertensive disorders of pregnancy and Obstetric hemorrhage were the major risk factors for ICU admission. Majority of the admissions were in the Post-partum period with a high percentage occurring after Caesarean section. The commonest intervention offered was mechanical ventilation and ventilatory support reduced the length of ICU stay to 1-2 days for about 70% of the patients with subsequent discharge back to the ward. Mortality was high compared to what obtains in high income and well-resourced settings but comparable to reports from other parts of Nigeria and other LMIC. Late referrals, unbooked status, poor or no antenatal care, complications of preeclampsia and eclampsia, post Caesarean section postpartum and antepartum haemorrhage were important causes of death in this study.

RECOMMENDATIONS

There is a need for 1, training in emergency obstetrics so that the complication can be managed right at the time of occurrence 2,training for the junior doctors working in peripheral health centers in identifying at-risk cases and for timely referral. 3, we also advocate better referral linkage and preventive measures to reduce the occurrence of eclampsia, post-partum haemorrhage while improvement in the quality of care should also be advocated for. 4, A separate ICU or high dependency unit (HDU) situated near the labour ward will prevent delay in patient transfer as there are patients in need of ICU who cannot get it. Establishment of functional HDU may help in earlier admission of critically ill patients for better observation. It may also reduce the burden of admissions to ICU, as HDU can be used for observation of patients not fit for ward observation. **.** Reportedly HDU meets the needs of half the obstetric population requiring high quality care and its use is known to reduce the number of expensive ICU admissions by 53%, while guaranteeing expert obstetric and critical care management (Okafor *et al,* 2011; Zeeman, 2006; Butwick & Carvalho, 2007)**.** Awareness should also be created among the population regarding the importance of adequate antenatal care ,detection of danger signs of various obstetric complications and need for contacting medical facilities in case of emergency situations.

LIMITATION OF THE STUDY

This study has several limitations. As with retrospective studies, any missing data from patient files

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affect the reliability of the data, but this was minimised by reviewing all files from the records department and the ICU. It did not include some other factors known to influence pregnancy outcome such as infectious diseases and socio-economic status of the mothers (educational level and employment status). Thus, further research especially in the form of prospective studies in a large cohort of women is necessary especially for our environment. A second limitation was that the frequency of obstetric ICU admissions is affected by the standard of obstetric care and the threshold admission criteria determined by obstetricians, anaesthetists, and intensive care physicians and the ability of the patients to pay the required admission deposit before admission into the ICU. Most of these patients were not captured in our data collection. As a result, ICU admissions may not truly reflect the standard of obstetric care. Thirdly it is a single institution study. The provision of critical care in sub-Saharan African countries is very limited and generally only available at central referral hospitals. Future studies may try to aggregate data from several referral hospitals to increase generalizability. In the same vein, given that our sample size is small, these data are not meant to make broad generalizations about public health based on all the clinical data presented, but rather to call attention and to provide pilot data for future investigations. Finally, because of limited ICU bed availability and limited resources on the part of the patients, some proportion of critically ill obstetric subjects are likely to be treated in other hospital areas such as the wards. This is not uncommon given the severely limited supply of ICU beds in LMIC. This is a reality of clinical care in resource-limited settings. Future studies may take this into account and register subjects from these areas. Another major limitation of our study is that scoring systems were not applied for most of our patients so we could not compare predicted outcomes in our patients with the observed outcome. While scoring systems have been widely used in ICUs in developed countries, their application is only beginning to gain momentum in developing countries like Nigeria. We were also not able to determine socioeconomic factors related with ICU admission because being a retrospective studies some of this information were not available.

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