ORIGINAL RESEARCH ARTICLE

Quality Indicators and Outcomes of Emergency Caesarean Deliveries at a District-level Maternity Hospital

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Abstract

The objective of this research study is to identify quality indicators of cesarean deliveries and determine their relationship to neonatal and maternal morbidity and mortality in one high volume maternity hospital in Lilongwe, Malawi. Demographic, perioperative, and postoperative data were collected on all cesarean deliveries over three months. Indicators of quality (antibiotic administration, use of oxytocin, decision-to-incision time, and uterine incision type) were compared to maternal morbidities (postpartum hemorrhage, fistula and wound infection) and neonatal mortality. Causes of delays in decision to incision time were identified. 513 cesarean deliveries were performed during the study period, with no maternal deaths and 39 neonatal deaths. Adherence to oxytocin and antibiotic administration was high but not complete, with greater adherence to the former (97.1% vs 82.6%). The decision to incision time between women with and without neonatal deaths was similar (1.62 hours vs 1.49 hours, p=0.41). Most delays were attributed to a busy operating theatre (49.1%) and delayed transfer to the operating theatre (26.9%). Uterine rupture and cesarean hysterectomy were associated with an outcome of neonatal death (p<0.001). Infrastructure and personnel limitations are major barriers to the improvement of quality of cesarean deliveries. Future endeavors towards quality improvement must address these deficiencies. *(Afr J Reprod Health 2015; 19[3]: 61-67).*

Keywords: obstetrics, international, quality, low resource

Résumé

L'objectif de cette étude est d'identifier les indicateurs de qualité de césariennes et de déterminer leur relation à la morbidité et la mortalité néonatale et maternelle dans un hôpital de la maternité de volume élevé à Lilongwe, au Malawi. Démographique, périopératoire, et les données post-opératoires ont été recueillies sur tous les accouchements par césarienne plus de trois mois. Indicateurs de qualité (l'administration d'antibiotiques, l'utilisation de l'ocytocine, l e temps de décision à l'incision, et de l'utérus de type d'incision) ont été comparés à de morbidité maternelle (hémorragie post-partum, la fistule et infection de la plaie) et la mortalité néonatale. Les causes de retards dans la prise à l'incision du temps ont été identifiés. 513 césariennes ont été effectuées au cours de la période de l'étude, aucun décès maternels et 39 décès néonatals. L'adhésion à l'ocytocine et l'administration d'antibiotiques était haute mais pas complet, avec une plus grande adhésion à l'ancien (97,1% vs 82,6%). La décision d'incision de temps entre les femmes avec et sans décès néonatals était similaire (1,62 vs 1,49 heures heures, p = 0,41). La plupart des retards ont été attribués à un théâtre chargé d'exploitation (49,1%) et le transfert retardé au théâtre d'exploitation (26,9%). La rupture utérine et l'hystérectomie césarienne ont été associées à un résultat de décès néonatal (p <0,001). Infrastructure et du personnel des limitations sont des obstacles majeurs à l'amélioration de la qualité des accouchements par césarienne. Les efforts futurs vers amélioration de la qualité doivent combler ces lacunes. *(Afr J Reprod Health 2015; 19[3]: 61-67).*

Mots-clés: obstétrique, internationale, de qualité, à faible ressource

Introduction

The number of emergency caesarean deliveries at hospitals in low resource settings is increasing, placing a greater strain on already overburdened personnel and health systems. Reducing maternal mortality and morbidity and the accompanying neonatal deaths by establishing basic and comprehensive emergency obstetric care (EmOC) centres is among the many challenges for ministries of health and their partners. The World Health Organization (WHO) has identified a set of criteria that designate basic and comprehensive EmOC centres, based on the availability of services such as blood transfusions and caesarean deliveries, which it then uses to identify "met need" within a certain geographic area[1]. Although transitioning from home deliveries to facility-based deliveries is integral to reducing maternal and neonatal morbidity and mortality, ensuring

quality care at the health facility is equally important.

The Malawi Safe Motherhood Initiative began in 1997 with a goal to reduce maternal and neonatal mortality. This program assessed the availability of existing EmOC services and tracked improvements and compliance with WHO guidelines over three years in the southern region of Malawi[2]. At the end of two years, the availability of comprehensive EmOC surpassed target levels, yet case fatality rates (i.e. maternal deaths) remained above 2%, and in some areas, above 5%[3]. Such findings indicate that although availability of services such as caesarean delivery is on par, the quality of the services remains poor.

Many EmOC interventions have been tested and validated as ways to bridge the gap between quantity and quality. Checklists have been shown to be low-cost interventions that can have substantial impacts on reducing surgical complications and case fatality rates[4,5]. Facility-based maternal death reviews and criterion-based clinical audits have also been proposed as successful methods to improve the quality of maternal health services in hospitals[6,7]. Despite the evidence, high-yield, low-cost interventions that can address inadequacies in emergency caesarean delivery quality remain largely unimplemented[8].

In order to understand the causes of implementation failure, it is imperative to assess the quality of existing practices and identify conditions that act as barriers to improvement. Currently, there are no standards for assessing the baseline quality of caesarean deliveries provided at comprehensive EmOC centers[9]. As the focus has been extensively on maternal mortality following caesarean delivery, little has been written on maternal morbidities after caesarean such as obstetric fistula, wound infection and postpartum haemorrhage. Furthermore, a simple, broad, validated checklist for caesarean delivery to supplement the current recommendations and to provide structure to future assessments of quality does not exist[10].

We sought to represent one comprehensive EmOC facility's experience in providing emergency caesarean deliveries, by focusing on quality indicators that have been reported in the literature as independently associated with outcomes in caesarean delivery and could be easily tracked in the hospital setting[1]. The objective is to assess barriers to quality caesarean delivery in the hospital setting, and determine how closely these indicators are linked to maternal morbidity and mortality, and neonatal mortality.

Materials and Methods

Bwaila Maternity Hospital is a district-level public hospital in Lilongwe, Malawi that serves the main city and the surrounding rural villages. It is the busiest maternity hospital in Malawi with over 1000 deliveries per month. Bwaila acts as the primary maternal health care centre for emergency cases in a city of 750,000 people. At the time of this study, Bwaila Maternity Hospital had one fully-functioning operating theatre used primarily for emergency caesarean deliveries, and secondarily for other emergent obstetric needs. It had three full-time anaesthetists, nine clinical officers, and two medical officers who served all wards of the hospital.

Comprehensive maternity data at Bwaila Maternity Hospital is collected by Bwaila staff using logbooks as a part of ministry of health guidelines. The data collected encompasses HIV serostatus of the mother, staff member performing delivery, mortality outcomes of the mother and her infant, any complications with the mother or the infant, the type of delivery, and the location of delivery. Information is transferred from the logbooks to an electronic database on a monthly basis. We compared our population to composite information on women delivering at Bwaila Hospital from previous years' logbooks to look for differences in neonatal mortality rates amongst caesarean and vaginal delivery groups and to determine the annual percentage of women receiving a caesarean delivery at the hospital.

The quality indicator program was implemented over a three-month period from February 2012 through May 2012. Specific quality indicators were selected based on their relationship to good outcomes[1] and the ease with which the

information could be collected. Written data was collected by fully-trained, bilingual Malawian data collectors. There was 24 hours a day, 7 days a week in-house coverage by the data collectors during the entire study period. In addition to the routinely collected data from the MOH registers, we collected obstetric, preoperative, operative and postoperative data. Patients were followed from the time they were identified as requiring a caesarean delivery to their discharge from Bwaila Maternity Hospital. No data was collected after patient discharge from the hospital. Operative information was entered on the data form in real time by one of the three trained anaesthetists. The decision to perform caesarean section was marked in the patient chart. The anaesthetists were also asked to identify whether decision to incision time for the caesarean delivery was longer than one hour, and, if so, select from a list of possible causes of the delay.

The program evaluation was approved by the Malawi National Health Sciences Research Committee and the University Of North Carolina Protection Of Human Subject Committee. All written data was double-entered by the data collectors into REDCap, after which it was aggregated and analyzed using STATA 11. Regression models were used to assess for any relationships between maternal morbidity and neonatal mortality following caesarean delivery and quality indicators cited in the literature as influencing surgical outcomes. Quality indicators included perioperative antibiotic administration, use of intraoperative oxytocin, uterine incision type, and decision to incision time. Maternal morbidities analyzed were postpartum haemorrhage (intraoperative or postoperative), postoperative
infection and development of obstetric fistula. In cases of delays to decision to incision time, data on the causes of the delay was collected.

Results

Of note, not all data entry forms were 100%
complete. For that reason, the denominators vary amongst different data points.

During the 3-month study period, there were 3182 vaginal deliveries and 513 caesarean deliveries. Neonatal mortality was higher among women receiving caesarean delivery (39/508, 7.7%) compared to overall deliveries during the same time period (92/3695, 2.4%). Amongst caesarean deliveries in the study group, the majority of the deaths were stillborn (N=24), followed by low birth weight (N=2), birth asphyxia (N=1), prematurity (N=1) and malformation (N=1). The causes of 10 neonatal deaths were not reported. Those with caesarean delivery (N=508) had 3.26 times higher odds of neonatal death than the overall delivery group (N=3182, $p<0.001$).

The number of caesarean deliveries performed at Bwaila Hospital during the period February through May increased steadily from 405 in 2010, to 424 in 2011, to 513 in 2012. The number of caesarean deliveries performed as a percentage of total deliveries increased from 11.8%, to 12.0%, to 13.8% ($p=0.014$).

The majority of women in the study population (99.2%, N=478) came from Lilongwe district, mostly from areas in close proximity to the hospital (Table 1). The most common indications for caesarean delivery were prior caesarean delivery (23.9%), cephalopelvic disproportion or obstructed labour (22.0%) and non-reassuring fetal heart rate (19.7%). Five out of 481 patients (1.0%) received a hysterectomy during caesarean delivery. Of the 22 women requiring intra-operative blood transfusion, 16 (72.7%) received it. One-hundred and five out of 475 patients (22.1%) received a tubal ligation.

There were no maternal deaths following caesarean delivery leading up to discharge during the three-month study period. There was 1 case of obstetric fistula (0.2%, N=474), 1 case of wound infection (0.2%, N=474), and 3 cases of postpartum haemorrhage (0.6%, N=460). No direct correlations were found between maternal morbidity and quality indicators. Perioperative antibiotic coverage was high (82.6%), and the majority of women received chloramphenicol (83.0%). However, when subdivided into the percentage of women who received the antibiotics

within one hour of skin incision, the number is much lower (49.0%). Amongst the sixteen women who developed postoperative fever (temperature >=38C), average time to presentation was 1.6 days. The mean duration of stay for all women was 4.7 days (N=470). See Table 1 for other perioperative findings.

Table 1: Demographic and Perioperative Findings Amongst Women Receiving Caesarean Section at Bwaila Maternity

Demographic/Perioperative Finding	*Percentage*
Age in years (mean=24.9 ± 5.8)	
14-24	51.7
25-35	44.1
> 35	4.2
HIV status (N=470)	
Negative	82.0
Positive	15.1
Unknown	2.9
HIV treatment status (N=73)	
On treatment	61.6
Unknown	31.2
Not on treatment	4.1
Gravidity (mean=2.55 ± 1.7)	
1	34.2
2-4	54.2
>4	11.6
Parity (mean=1.47 ± 1.6)	
0	35.6
1-3	54.2
>3	10.1
Number of living children (mean=1.22 ± 1.4)	
0	42.3
1-3	49.4
>3	8.3
Duration of labor in hours (mean=12.9 ± 12.3) *	
<10	50.3
10-20	29.2
>20	20.5
Perioperative antibiotic use	
Yes	82.6
No	17.4
Type of antibiotic used	
Chloramphenicol	83.0
Penicillin	13.8
Ceftriaxone/other	0.8
Intraoperative oxytocin administration	
Yes	97.1
No	2.9
Incision used on uterus	
Transverse	96.2
Vertical	3.8
Individual performing cesarean section	
Clinical officer	85.7
Intern	8.1
Medical officer	5.2
Consultant	1.0

*Hospital. (N=484)

Table 2: Delays in Decision to Incision Time

Cause of delay	**Number of patients (%)**
Operating theatre occupied	192 (66.2)
Delayed transfer from labor ward	78 (26.9)
Other	11 (3.8)
Water shortage	*6 (2.1)*
Electricity outage	*2 (0.6)*
Patient refused	*1 (0.3)*
Clinician undecided	*1 (0.3)*
Not recorded	*1 (0.3)*
Equipment unavailable	5 (1.7)
Clinician unavailable	4 (1.4)

Average decision to incision time was 1.69 hours (N=459). Various reasons were noted as causes of delays to decision to incision time (Table 2). Uterine rupture as an indication for caesarean delivery and hysterectomy at delivery were the only significant contributors to neonatal death (Table 3). No quality indicators (antibiotic use, oxytocin administration, decision to incision time and uterine incision type) were associated with neonatal death. In fact, amongst women receiving caesarean delivery for obstructed labour, those with live babies were 11.7 times more likely to have experienced a delay than women with death as a neonatal outcome (p=0.008).

Discussion

The provision of high quality cesarean deliveries in low resource settings faces numerous challenges, particularly as patient volumes at health facilities continue to increase. In this high burden facility, an evaluation of quality indicators demonstrated several areas where quality appeared adequate, yet time to operation and perioperative antibiotic administration remained below internationally accepted standards[11,12]. Although there was no association between the markers of

Table 3: Relationships between Factors Surrounding Caesarean Delivery and Neonatal Death as an Outcome*.

	Alive (N=469)	**Dead (N=39)**	***P* value**
Mean			
Age	24.8 ± 5.8	25.6 ± 5.9	*0.74*
Duration of labor (hours)	12.7 ± 12.3	15.0 ± 13.1	*0.83*
Decision to incision time (hours)	1.71 ± 3.1	1.49 ± 1.5	*0.41*
Admission to incision time (hours) N=364ᵠ	10.22 ± 10.92	11.23 ± 12.46	*0.67*
Count (%)			
HIV positive mother	72 (15.8)	4 (10.8)	*0.61*
One or more prior cesarean sections	141 (37.1)	10 (2.1)	*0.79*
Indication for cesarean delivery*			
Previous scar	117 (24.9)	8 (20.5)	*0.54*
Cephalopelvic disproportion	131 (27.9)	6 (15.4)	*0.09*
Non-reassuring fetal heart rate	85 (18.1)	7 (17.9)	*0.98*
Prolonged labor	49 (10.4)	3 (7.7)	*0.58*
Breech presentation	48 (10.2)	0 (0)	*0.04*
Uterine rupture	0 (0)	6 (15.4)	*<0.00 1*
Hysterectomy at cesarean section	2 (0.5)	2 (6.5)	*<0.00 1*
Antibiotics given preoperatively	349 (78.2)	29 (85.3)	*0.64*
Oxytocin given intraoperatively	433 (97.1)	33 (97.1)	*0.31*

ᵠWomen with a 50 hour or greater wait time were excluded under the assumption they were not in active labour on presentation

**Only the most common indications and/or any significant values are presented*

quality and maternal morbidity, neonatal mortality rates following caesarean delivery remain high and are associated with deliveries that require more complex surgical management i.e. uterine rupture and haemorrhage requiring hysterectomy.

Administration of oxytocin, despite various resource limitations, and use of a transverse incision on the uterus at Bwaila Maternity Hospital was high (97.1% and 96.2%, respectively). This can be attributed not only to the relative low cost and ease of implementation of these two interventions, but also to extensive training of the staff. Oxytocin is directly linked to the prevention of postpartum haemorrhage, and a transverse incision on the uterus significantly reduces the likelihood of uterine rupture with future pregnancies[11]. Staff at Bwaila are trained regularly on the prevention of both postpartum haemorrhage and uterine rupture, as rates of maternal morbidity and mortality due to these conditions remains high in sub-Saharan Africa and Malawi in particular[13].

This facility had a decision to incision time, defined as the duration of time from when the decision was made to perform caesarean section to when the initial incision was made, of 1.69 hours per caesarean section, far exceeding the recommended 30 minute standard. In this case, lack of operating theatre space and high patient volume contributed to delays in decision to incision time. Secondarily, lack of efficient patient transfer to the operating theatre was also a major contributor. As stillbirths comprise the majority of neonatal deaths, it is likely that most delays in caesarean delivery that resulted in stillbirth are experienced during the time preceding arrival to the hospital, rather than during the period the patient is waiting for surgery in the hospital. Nonetheless, to achieve the optimal 30 minute decision-to-incision time in this facility, an additional, fully-staffed operating theatre would be valuable. Furthermore, simple interventions such as checklists, clinical audits, and training sessions with staff can streamline patient flow and reduce delays. Given the important contribution of water and electricity shortages to delays, water and sanitation infrastructure must be capable of keeping up with demand.

Antibiotic administration practices were below complete coverage, at 82.6%. The majority of women were given chloramphenicol (83.0%) which in one study based in another Lilongwe hospital, has been found to be largely ineffective against gram negative bacteria[14]. The implications of this study on prevention of peri-operative infectious morbidity in caesarean deliveries is unknown. Goals for coverage should be 100%, and first generation cephalosporins prior to skin incision are the current recommendation[11]. Poor communication between the labour ward and the

operating theatre and inconsistent paper documentation regarding administration led to failures in achieving greater antibiotic coverage. In order to address this problem, medication supply chains must be improved on a national and local level and improved documentation of antibiotic administration must be emphasized.

Maternal morbidity following caesarean delivery in this study may be falsely low, owing to the fact that patients were only followed up to the day of discharge, which was four days on average. Actual incidence of wound infection is likely higher than the 0.2% value reported as it can take one or more weeks for the signs and symptoms of wound infections to develop[15]. Obstetric fistula is often missed within the immediate postoperative phase, as the average number of days to presentation is thought to be closer to one week[16]. More accurate rates of maternal morbidity could be determined if patients were followed up to 30 days postoperatively and a larger sample size was available. A project with the resources to track patients back to their local health centres and villages would be more suited to the task.

Neonatal mortality was five times higher in the caesarean delivery versus vaginal delivery group, which is a greater odds ratio than has been reported in other countries[17]. Uterine rupture and the need for a hysterectomy during caesarean delivery were overwhelmingly associated with poor neonatal outcomes when compared to other factors contributing to need for caesarean delivery. These outcomes may be associated with the nature of the obstetric complication itself rather than the quality of the surgical procedure. Uterine rupture and uncontrolled postpartum haemorrhage require hysterectomy. Hysterectomy at the time of caesarean is both technically challenging and highly morbid for the patient, especially in low resource settings[18]. In developing countries, uterine rupture is reported to be as common as 1% of all caesarean deliveries, and in one Malawian district hospital, occurred on a weekly basis[12,19]. Clinical officers perform the majority of caesarean deliveries in Malawi, and are not routinely trained on how to perform emergency hysterectomies[20]. If the morbidity and mortality associated with intraoperative management of emergent hysterectomy is to be avoided, clinical officers must receive standardized training in how to perform hysterectomies at the time of uterine rupture and hemorrhage[21].

This study highlights the complexities of providing high quality caesarean deliveries under the constraints of limited resources. However, given the multitude of low-cost interventions available to address deficiencies of quality, it is imperative to establish adherence to a well-defined set of standards that improve maternal and neonatal outcomes following caesarean delivery. Decision-to-incision time, antibiotic usage, oxytocin administration and incision type are just a sampling of evidence-based quality markers[8]. Comprehensive databases should be maintained and periodically reviewed to delineate causes of poor maternal and neonatal outcomes. In establishing standards for monitoring and quality improvement, facilities will be better equipped to plan interventions to address the growing demand for comprehensive emergency obstetric care services.

Conflict

The authors of this paper do not have any conflicts of interest to report. Funding for this research was provided by the Doris Duke Charitable Foundation.

Contribution of Authors

Melike Harfouche conceived and designed the study, and was the primary person who collected and analyzed the data. Mina Hosseinipour assisted with the design of the study, as well as provided support for data collection and structuring of the manuscript. Stephen Kaliti provided assistance with the design of the study. Jeffrey Wilkinson aided in the design of the study, and provided support in terms of background knowledge and on-site support in terms of study design, and also assisted with the structuring of the subsequent analysis and manuscript.

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