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Perioperative Management and Outcomes After Cesarean Section - A Cross-Sectional Study From Rural Rwanda

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Abstract

Background: Cesarean sections (c-sections), the most common surgical procedures performed worldwide, are essential in reducing maternal and neonatal deaths. There is a paucity of research studies on c-section care and outcomes in rural African settings. The objective of this study was to describe demographic characteristics, clinical management, and maternal and neonatal outcomes among women receiving c-sections at Kirehe District Hospital (KDH) in rural Rwanda.

Methods: This retrospective cohort study included all women aged 18 years residing in KDH catchment area who delivered by c-section at KDH between April 1 and September 30, 2017. Demographic and clinical characteristics of these women and their newborns were collected using patient interviews and medical chart extraction. Descriptive analyses were performed and frequency and percentages are reported.

Results: Of the 621 women included in the study, 45.7% (n=284) were aged 25–34 years; 42.2% (n=262) were married; 67.5% (n=419) had primary education; and 75.7% (n=470) were farmers by occupation. Burundi refugees living in the nearby Mahama Refugee Camp comprised 13.7%

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Author contributions:

Christian Mazimpaka and Eline Uwitonze led literature review, data analysis, and manuscript development, with assistance from Teena Cherian. Bethany Hedt-Gauthier, Fredrick Kateera, and Robert Riviello were the principal study investigators and provided overall supervision for the project. Ziad El-Khatib, Kristin Sonderman, Magdalena Gruendl, Caste Habiyakare, Sadoscar Hakizimana, and Daniella Kayitesi helped with data interpretation and manuscript drafting. Theoneste Nkurunziza led the implementation of the project and supported data collection and interpretation as well as manuscript writing. All authors read and approved the final draft of the manuscript.

Conflicts of Interest:

Authors declare that they have no competing interests.

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(n=85) of the study population. The most common indication for c-section was having undergone a c-section previously (31.9%, n=198), followed by acute fetal distress (30.8%, n=191). Among those with previous c-section as the sole indication for surgery, 85.4% presented as either urgent or emergent cases. Postoperatively, 67.7% spent less than four days at the hospital and 96.1% had no postoperative complications prior to discharge. Approximately 10% (59/572) of neonates were admitted to the neonatal unit, with the most common reason being neonatal infection (59.6%, n=31).

Conclusions: Our study found that previous delivery via c-section was the primary indication for c-section, and that most of these were emergent or urgent upon presentation. This study highlights the need for further research to explore the feasibility, safety, and appropriateness of Vaginal Birth After Cesarean (VBAC) in rural district hospitals in sub-Saharan Africa.

Keywords

cesarean section; Sub-Saharan Africa; surgery; Vaginal Birth After Cesarean; maternal health; child health; refugees

Introduction

Cesarean sections (c-sections) are the most common surgical operation globally, accounting for nearly 1 in every 14 surgeries performed worldwide (1). Access to c-section delivery is essential in reducing unnecessary maternal and neonatal deaths (2) and increased access to c-section care has contributed to the rapid decrease in maternal mortality worldwide over the last decade (3, 4). Still, sub-Saharan African women continue to have a higher risk of dying during childbirth than women anywhere else in the world (5). Although there has been an increase in c-section rates globally (6, 7), only 3.5 % of newborns are delivered via c-section in sub-Saharan Africa (6), which is below the 10% rate recommended by the World Health Organization (WHO) to reduce maternal and neonatal mortality (8). Further, delays in access to c-section delivery have been associated with poor neonatal outcomes in this context (4, 9).

Rwanda has made remarkable advances in healthcare. There have been rapid declines in maternal and child mortality with maternal mortality decreasing from 910 per 100,000 live births in 1990 to 210 per 100,000 live births in 2015 (10). C-sections account for over 60% of all surgeries performed at district hospitals (11) and in 2015, approximately 40% of all deliveries at district hospitals in Rwanda are via c-sections (12). Approximately 11.1% of all babies are born by c-section in rural Rwanda (10).

Most literature on c-sections in sub-Saharan Africa report on cesarean deliveries in urban and tertiary hospitals (13–15). However, because 45% of the world's population live in rural settings (16) and the global c-section rate is rising, it is important to characterize c-section patients in rural hospitals and elucidate the type and quality of care provided to them in order to improve maternal and newborn care and outcomes in this settings. The objective of this study was to describe the characteristics of patients delivering by c-section at the Kirehe District Hospital (KDH) in rural Rwanda, the care received by these women, and the maternal and neonatal outcomes during a study period of six months.

Methods

Study setting:

KDH is a 236-bed facility run by the Rwanda Ministry of Health (RMOH) and located in the Eastern Province of Rwanda. KDH receives technical and financial support from Partners In Health/Inshuti Mu Buzima (PIH/IMB), a medical non-profit organization that has been supporting the RMOH since 2005. The goal of the partnership between RMOH and PIH/IMB is to deliver quality health care in three rural districts, including Kirehe District. KDH serves a population of 364,000 people (10) and receives patients transferred from 16 surrounding health care centers within Kirehe District. In addition, the Mahama Refugee Camp (established in April 2015 for Burundian refugees) has two health centers that refer patients to KDH. As of January 2018, KDH had 76 nurses, 14 midwives, and 14 doctors working in the hospital. An average of 445 babies are delivered at KDH per month, for an average of 381 deliveries per midwife per year which far exceeds the 175 births per midwife per year recommended by WHO (18,17). At KDH 27% of babies are delivered via c-section (18); the overall c-section rate for Eastern Province is 11.4%, while the c-section rate of Kirehe District is 7.8% (10).

In Rwanda, about 90% of women deliver in a health care facility (10). Women in labor first present to the health center for delivery, where they are referred to the district hospital if they are identified as a high-risk pregnancy or present complications that cannot be managed at the health center. The first medical examination of a pregnant woman is at the district hospital and it is performed by a general practitioner (GP). If the woman was referred for a c-section delivery, then she will be classified as: i) emergent, i.e. requiring an immediate intervention; ii), urgent, i.e. the patient can wait for intervention until she is medically stable; or iii) elective, i.e. planned c-section. After the c-section, the patient is admitted to the postoperative ward, monitored by midwives and nurses and evaluated by a GP who decides when the patient will be discharged from the district hospital. The neonates stay with the mother when there are no medical indications for admission to the neonatal unit.

Study design and population:

This study is a secondary analysis of baseline data collected as part of a larger prospective cohort study assessing the use of mHealth technology to identify and refer surgical site infections in Rwanda (19–20). Our analyses included all adult women (≥ 18 years old) who delivered at KDH via c-section between April 1 through September 30, 2017 and resided in Kirehe District (including women residing in Mahama Refugee Camp within the district). In addition to data available through the larger study, we extracted neonatal outcomes data from patients' medical files. Since we enrolled patients on postoperative day 1, those who died during or after c-section and before enrollment were not captured in this study.

Data collection and analysis:

All data were entered into REDCap (21) - a secure, web-based data capture application - using password-protected tablets. Demographic information and travel time to receive c-section were collected by interviewing the patients. Clinical history and maternal and neonatal outcomes data were extracted from patients' medical charts. Maternal outcomes

included intraoperative complications such as excessive bleeding requiring transfusion and postoperative complications prior to discharge such as surgical site infection, postoperative bleeding (excessive bleeding requiring transfusion). Neonatal outcomes included death, alive and discharged, admission to neonatal unit, or transfer to tertiary facility. If admitted to neonatal unit, reason for admission was also collected from the charts. Additionally, we collected neonate's APGAR score at birth. Data on neonatal outcomes were collected retrospectively from the mothers' medical charts at KDH. The two datasets, mother's data and neonate's data, were linked using mother's study identification number. Patients' demographic information, clinical management, and outcomes were summarized using frequencies and percentages or median and interquartile range (IQR). Data analyses were done using Stata version 15 (StataCorp, College Station, Texas, USA).

Ethics:

All women provided signed informed consent in local language (Kinyarwanda) prior to data collection. Of all 622 women approached to consent for the study, one woman (0.2%) did not consent to participate. For women who couldn't read, the study data collector read and explained the consent form in Kinyarwanda to the patients before obtaining their consent. We received scientific and ethical approval from the Rwanda National Ethics Committee (Kigali, Rwanda, No. 848/RNEC/2016) as well as from Partners Human Research Committee (Boston, USA, No. 2016P001943/MGH).

Results

Of the 621 women enrolled, nearly half (45.7%, n=284) were 25–34 years of age, 419 (67.5%) had only primary education; had income levels below the poverty line (n=585, 94.2%), and were farmers (n=470, 75.7%) (Table 1). Of note, 13.7% (n=85) of our study population were Burundian women living in the refugee camp. The median duration of travel time to the hospital - which included time spent traveling from home to health center, waiting for assessment and referral at the health center, and completing the transfer from the health center to the hospital - was 5.8 hours (IQR: 2.5, 18 hours). Of the 621 c-sections, 619 (99.7%) were performed by GPs, 10 (1.6%) were performed by Obstetricians-gynecologists, and 3 (0.5%) were performed by visiting general surgeons.

Previous c-section was the most common indication for the current c-section (n=198, 31.9%), followed by acute fetal distress (n=191, 30.8%) (Table 2). Almost half (n=309, 49.8%) of the women had an urgent indication for c-section and few (n=26, 4.2 %) were elective. Among those with previous c-section as the sole indication for surgery (n=144, 23.2%), 85.4% presented as either urgent or emergent cases. Most women (n=574, 93.2%) received c-section within the first 24 hours after admission. Of these, 275 (97.5%) presented as emergent, 283 (91.9%) presented as urgent, and 16 (61.5%) presented as elective. After c-section, 420 (67.7%) women spent at least three days in the hospital and the median length of stay was three days (IQR: 3, 4 days).

Most women (98.4%, n=611) experienced no complications during the c-section procedure and 96.1% (n=597) did not experience any postoperative complication prior to discharge (Table 3). Eleven (1.8%) women developed a surgical site infection while at the hospital. Of

the 10 (1.6%) women with any intraoperative complications, 6 (60%) were emergent, three (30%) were urgent, and one (10%) was elective. Of the 24 (3.9%) women with postoperative complications, 15 (62.5%) were emergent, 9 (37.5%) were urgent, and none were elective. Eleven (1.8%) women developed a surgical site infection while at the hospital. There was no maternal death recorded among study participants. Neonatal outcome data were available for 572 (92.1%) births of whom, 497 (86.9%) neonates were alive and discharged, 59 (10.3%) were admitted to neonatology, most commonly due to infection (n=31, 59.6%), and 15 (2.6%) died.

Discussion

Our findings shed light on the demographic and clinical characteristics of women receiving c-sections at a rural district hospital. KDH represents a typical rural African health facility serving a poor population with little education and who frequently live far from the hospital. Unique to our study population were Burundian refugees from the Mahama Refugee Camp, accounting for nearly one in seven c-sections at KDH.

Nearly a third of women who delivered via a c-section had a previous c-section as the only indication for the current c-section. This is higher than the 1.7%–14% found in other studies in the region (22–25). Of concern, nearly all women with a previous c-section as the only indication came in as emergent or urgent cases. Delays in the referral process and a lack of planning for hospital delivery among these women may explain this observation. Improved planning and care management may enable these women to deliver via a scheduled c-section rather than presenting for delivery in critical conditions. Furthermore, given the potential harm relating to multiple cesareans (26) and strong evidence for the safety of Vaginal Birth After Cesarean (VBAC) in Africa (19, 27–28), there is an opportunity to explore the capacity of health care providers and facilities to provide safe VBAC. Although VBAC is not part of the Rwandan obstetric protocols (30), all tertiary facilities in Rwanda support VBAC when inter-pregnancy interval is greater than 18 months (31). RMOH's current strategies to reinforce obstetric services at district hospitals with specialists and monitoring equipment (32) may make VBAC a more viable option at these facilities.

In this study, neonatal infections were the most common cause of admission to the neonatal unit, constituting nearly two-thirds of all admissions. To the best of our knowledge, there is a paucity of literature on the prevalence and causes of neonatal infections among babies specifically born by c-section in rural sub-Saharan Africa. Our study found that 60% of neonates for admitted for infections, which is higher than what was found in a rural South African hospital where 21% of all neonates, born vaginally or via c-section, were admitted due to infections (33). Further research is needed to elucidate the need for admission for neonates born via c-section and the etiology of these infections so that appropriate interventions could be implemented to reduce neonatal infections.

There were some limitations in our study. Recall or social desirability biases may have affected the patient self-reported data. However, the study data collectors were well trained to use probing methodology in order to obtain correct and reliable answers. Additionally, neonatal variables in this study were collected retrospectively from patients' charts, however,

some charts were missing and thus not all neonates' outcomes were captured in our results. The missing data may affect accuracy of our findings, though there is no indication that this data is missing not at random. In addition, this study documented patients' clinical outcomes during their hospital stay and thus did not capture any data after patients' discharge. Furthermore, this study was conducted at a district hospital that is supported by a non-governmental organization (PIH/IMB) where the infrastructure and quality of care may be higher than they are at most district hospitals. Although this may affect the generalizability of this study, the population characteristics and structure of the health system at KDH are comparable to other district hospitals in Rwanda.

Conclusions:

Given the paucity of research regarding c-section care and outcomes in rural African settings, our study adds to the literature by describing c-section patient population and their care management at a rural district hospital in Rwanda. Our study found that previous delivery via c-section was the primary indication for c-section, which will result in high future demand for c-sections. This highlights the need for further studies to explore the appropriateness and uptake of VBAC as well as better c-section planning in rural district hospitals in sub-Saharan Africa.

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References:

1. Weiser TG, Haynes AB, Molina G, Lipsitz SR, Esquivel MM, Uribe-Leitz T, Fu R, Azad T, Chao TE, Berry WR, Gawande AA. Size and distribution of the global volume of surgery in 2012. *Bull World Health Organ.* 2016;94(3):201–209F. [PubMed: 26966331]
2. Irani M, Deering S. Challenges affecting access to cesarean delivery and strategies to overcome them in low-income countries. *Int J Gynaecol Obstet.* 2015;131(1):30–4. [PubMed: 26115791]
3. Uzuncakmak C, Ozcam H. Association between Maternal Mortality and Cesarean Section: Turkey Experience. *PLoS One.* 2016;11(11):e0166622.
4. Niyitegeka J, Nshimirimana G, Silverstein A, Odhiambo J, Lin Y, Nkurunziza T, Riviello R, Rulisa S, Banguti P, Magge H, Macharia M, Habimana R, Hedt-Gauthier B. Longer travel time to district hospital worsens neonatal outcomes: a retrospective cross-sectional study of the effect of delays in receiving emergency cesarean section in Rwanda. *BMC Pregnancy Childbirth.* 2017;17(1):242. [PubMed: 28743257]
5. UNICEF. Maternal Mortality. <https://data.unicef.org/topic/maternal-health/maternalmortality/>. Accessed on September 20, 2018.

6. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990–2014. *PLoS One*. 2016;11(2):e0148343.
7. Lancet The. Stemming the global caesarean section epidemic. *Lancet*. 2018;392(10155):1279. [PubMed: 30322560]
8. World Health Organization. WHO statement on caesarean section rates. https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/cs-statement/en/. Accessed on September 20, 2018.
9. Nyirahabimana N, Ufashingabire CM, Lin Y, Hedt-Gauthier B, Riviello R, Odhiambo J, Mubiligi J, Macharia M, Rulisa S, Uwicyeza I, Ngamije P, Nkikabahizi F, Nkurunziza T. Maternal predictors of neonatal outcomes after emergency cesarean section: a retrospective study in three rural district hospitals in Rwanda. *Matern Health Neonatol Perinatol*. 2017;3:11. [PubMed: 28630744]
10. National Institute of Statistics of Rwanda (NISR), Ministry of Health Rwanda (MOH) and ICF International. Rwanda Demographic and Health Survey 2014–15. NISR, MOH and ICF International: Rockville, 2015.
11. Petroze R, Nzayisenga A, Rusanganwa V, Ntakiyiruta G, Calland J. Comprehensive national analysis of emergency and essential surgical capacity in Rwanda. *Br J Surg*. 2012;99:436–43. [PubMed: 22237597]
12. National Institute of Statistics of Rwanda(NISR) statistical yearbook, 2016 <http://www.statistics.gov.rw/publication/statistical-yearbook-2016> Accessed on September 20, 2018
13. Nelson JP. Indications and appropriateness of caesarean sections performed in a tertiary referral centre in Uganda: a retrospective descriptive study. *Pan Afr Med J*. 2017;26:64. [PubMed: 28451041]
14. Juma S, Nyambati V, Karama M, Githuku J, Gura Z. Factors associated with caesarean sections among mothers delivering at Mama Lucy Kibaki Hospital, Nairobi, Kenya between January and March, 2015: a case-control study. *The Pan African Medical Journal*. 2017; 28(Suppl 1):7.
15. Worjolah A, Manongi R, Oneko O, Hoyo C, Daltveit A, Westreich D. Trends in cesarean section rates at a large East African referral hospital from 2005–2010. *Open Journal of Obstetrics and Gynecology*. 2012; 2: 255–261.
16. The World Bank. Rural population (% of total population). <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS>. Accessed on November 28, 2018.
17. Commission on Social Determinants of Health. Achieving health equity: from root causes to fair outcomes Interim state-ment. Geneva: World Health Organization, 2007
18. Rwanda Health Management Information System (HMIS) Jan-Oct, 2017
19. Sonderman KA, Nkurunziza T, Kateera F, Gruendl M, Koch R, Gaju E, Habiyakare C, Matousek A, Nahimana E, Ntakiyiruta G, Riviello R, Hedt-Gauthier BL. Using mobile health technology and community health workers to identify and refer caesarean-related surgical site infections in rural Rwanda: a randomized controlled trial protocol. *BMJ Open*. 2018;8(5):e022214.
20. Nkurunziza T, Kateera F, Sonderman K, Gruendl M, Nihwacu E, Ramadhan B, Cherian T, Nahimana E, Ntakiyiruta G, Habiyakare C, Ngamije P, Matousek A, Gaju E, Riviello R, Hedt-Gauthier B. Prevalence and predictors of surgical-site infection after caesarean section at a rural district hospital in Rwanda. *Br J Surg*. 2019;106(2):e121–e128. [PubMed: 30620071]
21. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):37781.
22. Chu K, Cortier H, Maldonado F, Mashant T, Ford N, Trelles M. Cesarean section rates and indications in sub-Saharan Africa: a multi-country study from Medecins sans Frontieres. *PLoS One*. 2012;7(9):e44484.
23. Fesseha N, Getachew A, Hiluf M, Gebrehiwot Y, Bailey P. A national review of cesarean delivery in Ethiopia. *Int J Gynaecol Obstet*. 2011;115(1):106–11. [PubMed: 21872239]
24. Kouanda S, Coulibaly A, Ouedraogo A, Millogo T, Meda BI, Dumont A. Audit of cesarean delivery in Burkina Faso. *Int J Gynaecol Obstet*. 2014;125(3):214–8. [PubMed: 24629788]
25. Vergnano S, Sharland M, Kazembe P, Mwansambo C, Heath PT. Neonatal sepsis: an international perspective. *Arch Dis Child Fetal Neonatal Ed*. 2005;90(3):F220–4. [PubMed: 15846011]

26. Makoha FW, Felimban HM, Fathuddien MA, Roomi F, Ghabra T. Multiple cesarean section morbidity. *Int J Gynaecol Obstet.* 2004 12;87(3):227–32. [PubMed: 15548394]
27. Seffah JD, Adu-Bonsaffoh K. VAGINAL BIRTH AFTER A PREVIOUS CAESAREAN SECTION: CURRENT TRENDS AND OUTLOOK IN GHANA. *J West Afr Coll Surg.* 2014;4(2):1–25.
28. Guise JM, Eden K, Emeis C, Denman MA, Marshall N, Fu RR, Janik R, Nygren P, Walker M, McDonagh M. Vaginal birth after cesarean: new insights. *Evid Rep Technol Assess (Full Rep).* 2010;(191):1–397.
29. Ugwu GO, Iyoke CA, Onah HE, Egwuatu VE, Ezugwu FO. Maternal and perinatal outcomes of delivery after a previous Cesarean section in Enugu, Southeast Nigeria: a prospective observational study. *Int J Womens Health.* 2014;6:301–5. [PubMed: 24648774]
30. MOH/Rwanda, OBS&Gyn protocol, 2012 http://www.moh.gov.rw/fileadmin/templates/Clinical/OBS_Gyn_last-version.pdf Accessed on September 20, 2018
31. Rwanda Centre Hospitaliere Universitaire de Kigali, obstetric guidelines 2013
32. Rwanda Ministry of Health, Package of health service in public health facilities, 2017 http://moh.gov.rw/fileadmin/templates/Norms/Public_health_Facilities_service_packages_in_Rwanda.pdf Accessed on September 20, 2018
33. Hoque M, Haaq S, Islam R. Causes of neonatal admissions and deaths at a rural hospital in KwaZulu-Natal, South Africa. *Southern African Journal of Epidemiology and Infection.* 2011; 26(1): 26–29.

Table 1:

Demographic characteristics of women receiving c-section at Kirehe District Hospital, Rwanda

Characteristics (N=621)	n	(%)
Age (years)		
18–24	243	(39.1%)
25–34	284	(45.7%)
35	94	(15.1%)
Marital status		
Married	262	(42.2%)
Single	224	(36.1%)
Living with a partner	127	(20.5%)
Separated (widowed or divorced)	8	(1.3%)
Education		
No education	69	(11.1%)
Primary education	419	(67.5%)
Secondary education or higher	133	(21.4%)
Household monthly income		
Less than 37.5 USD	585	(94.2%)
37.5 USD or above	36	(5.8%)
Nationality		
Rwanda	536	(86.3%)
Burundi	85	(13.7%)
Health insurance		
Community based insurance	510	(82.1%)
UNHCR insurance	85	(13.7%)
Private insurance	21	(3.4%)
No insurance	5	(0.8%)
Occupation		
Farmer	470	(75.7%)
House wife	113	(18.2%)
Employed	33	(5.3%)
Student	5	(0.8%)
Travel time from home to hospital *, in hours (n=352); median (IQR)	5.8	(2.5–18.0)

UNHCR: United Nations High Commissioner for Refugees

* Total time spent to arrive at district hospital, including wait time at health center to receive referral

Table 2:

Clinical characteristics of women receiving c-section at Kirehe District Hospital, Rwanda

Characteristics (N=621)	n	(%)
Patient has comorbidity	17	(2.7%)
Indication for surgery *		
Previous c-section	198	(31.9%)
Acute fetal distress	191	(30.8%)
Breech presentation	84	(13.5%)
Prolonged labor	68	(11.0%)
Cephalopelvic disproportion	65	(10.5%)
Cord prolapse	49	(7.9%)
Hypertensive disorders	13	(2.1%)
Placenta previa	13	(2.1%)
Uterine rupture	9	(1.5%)
Other	16	(2.6%)
Surgical category		
Urgent	309	(49.8%)
Emergent	286	(46.1%)
Elective	26	(4.2%)
Surgical category for those with previous c-section as the only indication for surgery (n=144)		
Emergent	39	(27.1%)
Urgent	84	(58.3%)
Elective	21	(14.6%)
Type of anesthesia		
Regional	610	(98.2%)
General	11	(1.8%)
Time interval between admission and index procedure		
24 hours	574	(93.2%)
> 24 hours	42	(6.8%)
Length of stay at hospital post c-section		
3 days	420	(67.7%)
4–7 days	166	(26.7%)
> 7 days	34	(5.5%)
Type of provider performing c-section		
GP	619	(99.7%)
Obstetricians-gynecologists	10	(1.6%)
Visiting general surgeons	3	(0.5%)

* Percent total greater than 100% because one patient could have more than one indication for c-section

Table 3:

Maternal and neonatal outcomes following c-section at Kirehe District Hospital, Rwanda

	n	(%)
Maternal outcomes (N=621)		
Intra-operative complications		
None	611	(98.4%)
Excessive bleeding requiring transfusion	8	(1.3%)
Other	2	(0.3%)
Post-operative complications prior to discharge		
None	597	(96.1%)
Surgical site infection	11	(1.8%)
Post-operative bleeding	6	(1.0%)
Other	7	(1.1%)
Neonatal outcomes (N=572)		
Outcome		
Died	15	(2.6%)
Alive and discharged	497	(86.9%)
Alive and admitted to neonatal unit	59	(10.3%)
Alive and transferred to tertiary facility	1	(0.2%)
Reason for neonate's admission to neonatal unit *		
Prematurity	10	(19.2%)
Birth asphyxia	6	(11.5%)
Neonatal infection	31	(59.6%)
Congenital malformation	2	(3.8%)
Other	3	(5.8%)
Reason missing	12	(20.3%)
Apgar score at birth		
0-3	13	(2.3%)
4-6	28	(4.9%)
7-10	531	(92.8%)

* Percent total greater than 100% because one neonate could have more than one reason for admission to neonatal unit