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Fetal complications associated with operative deliveries in Jimma University Medical Centre

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Abstract

Introduction: *each type of operative delivery could have different neonatal birth complications. The obstetric care should be to reduce the risk of maternal and fetal morbidity and, where morbidity occurs, to minimize the likelihood of serious harm while maximizing maternal choice. Thus, this study was aimed to identify neonatal morbidity that occurred due to operative deliveries.* ***Methods:*** *a cross-sectional study design was employed to review a record of operative deliveries' registration charts from May 30, 2020 to May 30, 2021 in Jimma Medical Center. The study participants were selected by systematic random sampling technique. A tool developed from up-to-date similar literature was used to review charts. The checked data were*

entered into Epi-data manager 4.6 versions and exported and analyzed by SPSS 25 versions. Descriptive and bivariate logistic regression was computed for categorical variables. In the multivariate logistic regression, predictor variable having p-value < 0.05 were considered statistically significant associations. ***Results:*** *a total of 300 study participants were included in the study. Of which 24 (7.9%) and 2 (0.7%) neonates and mothers died respectively. The highest, 13 (54.2%), magnitude of fetal death was recorded among mothers delivered by vacuum-assisted delivery. Among mothers delivered by operative delivery, 105 (35.0%) developed neonatal birth complications. The commonest neonatal complication was minor scalp laceration (bruising) which accounts for 86 (28.8%) followed by cephalic hematoma, 6(2.0%). In the multivariate logistic regression, age of mother, (AOR=1.91, 95% CI: (1.31, 4.73)) and fetal birth weight, (AOR=2.56, 95% CI: (1.44, 10.91)) were associated with neonatal birth complications. Furthermore, a neonate delivered by forceps was 5 times more likely to develop fetal complications than those delivered by cesarean section, (AOR=4.70, 95% CI: (1.43, 11.31)).* ***Conclusion:*** *the proportion of neonatal complications due to operative deliveries was high. Age of mother, types of operative delivery, and fetal birth weight were predictors of neonatal complications among operatively delivered neonates.*

Introduction

An operative delivery is an obstetric procedure in which active measures are taken to undertake delivery. It can be divided into operative vaginal delivery (vacuum or forceps assisted vaginal delivery) and cesarean section delivery [1,2]. Operative vaginal delivery is an integral part of obstetric care globally in the setting of the prolonged second stage, with no reassuring fetal status, or limited maternal expulsive efforts [2-5]. In the last several years, it has seen a trend toward a decrease in the operative vaginal delivery rate but an upsurge in the cesarean section rate. In addition, vacuum-assisted vaginal delivery has been increasing while vaginal delivery using forceps has declined [1,6]. The magnitude of operative vaginal delivery varies between countries. It may be performed as infrequently as 1.4% of all deliveries in Istanbul to as often as 15% in Australia [7]. Discrepant rates may be related to differences in labor management [8]. Although there have been limited studies on the effects of operative vaginal delivery on the health of women and neonates, a report by the American College of Obstetrics and Gynecology has highlighted the potential for maternal and neonatal complications associated with operative vaginal delivery, although the risks associated with alternative procedures also must be considered [9]. On the other hand, although cesarean section delivery is typically a lifesaving procedure, it increases maternal and newborn adverse outcomes and health costs [10].

Health-related to poor socioeconomic and nutritional status, delays in seeking, accessing, and receiving quality healthcare in facilities contribute to cesarean delivery rates and increase risks of adverse fetal and maternal outcomes [6,11]. Furthermore, gestational age, high parity, preeclampsia, twining, and hydramnios are factors that contribute to adverse outcomes following cesarean section delivery [12]. Encouraging operative vaginal deliveries may help to reduce the unwarranted and raised cesarean section delivery rates [6,13]. Newborn intracranial injuries, shoulder dystocia cephalic hematoma, instrumental marks, bruising subconjunctival hemorrhage, brachial plexus injury, convulsions, and neonatal hyperbilirubinemia, are complications associated with operative vaginal deliveries [14]. These complications vary according to the types of procedure selected, it can be affected by gestational age, parity or gravidity, training, and experience of an obstetrician who conducts the delivery [4]. Neonates who are born by operative vaginal delivery have higher rates of birth trauma, as compared with those born by spontaneous vaginal delivery [2,4,8]. These complications can be reduced if the procedure is performed by a skilled health professional, thus

reducing the risk for women and their babies from cesarean section particularly in the second stage of labor [4,15]. Hence, this study was aimed to identify the magnitude of fetal outcomes and factors associated with it among mothers who gave birth by operative deliveries.

Methods

Study design and setting:a cross-sectional study design was employed to review mothers' charts that gave birth by operative delivery from May 30, 2020 to May 30, 2021. The study was conducted in Jimma Medical Center (JMC) which is part of Jimma University (JU). It is the only medical center in the southwest of Ethiopia which provides services for approximately 15,000 inpatients and 160,000 outpatients per year [16]. The services that are given by JU Medical Centre include emergency care, medical care, surgical care, ICU, OR, pathology, laboratory, pharmacy & other services. The Medical center has a total number of 1016 professional staff from different departments and 629 support staff. Among those, 641 are nurses and 145 are physicians [17].

Study population: charts of operative deliveries in JMC during the study period were the study population.

Eligibility criteria: records of all operative deliveries in the hospital from May 30, 2020 to May 30, 2021 were included, while incomplete documentation for key information and destructive delivery were excluded from the study.

Sample size determination and sampling procedure: a single population proportion formula was used to determine sample size(ni) for this study by considering 25% estimated proportion (p) fetal outcome of operative delivery developing a variety of complications, 95% confidence interval, the margin of error(d) 5% [18].

$$ni = \frac{(Z\alpha/2)^2 x\ p(1-p)}{d^2} = 288$$

Since the study the total study population (N), the number of operative deliveries admitted in Jimma Medical Center was 6720, were less than 10,000 the correction formula was used to calculate the final sample size (Nf). This number of patients was taken from a one-year report to the HMIS office of the obstetric and gynecological wards. Nf =ni*Ni/ni+N=276.

Finally, after adding a 10% incompletion rate, a total of 304 operative delivery patients´ charts were targeted for the study. To select each study participant, a medical record number of operative deliveries in one year were drawn from the record office. Then systematic random sampling technique with a sampling interval of 22 (6720/304) was used. The first case was selected by simple random sampling (lottery method).

Data collection too and procedures: a checklist developed from updated similar literature which contains socio-demographic and obstetrics characteristics, fetal and maternal outcomes, and fetal complications were used to review operative delivery's medical record chart [4,7,10,12,18,19]. Medical record chart was reviewed by four BSc nurses.

Data quality assurance: the chart review instrument was pilot tested on 5% of the sample size, and reliability statistics were computed with Cronbach's alpha of 0. 81. Data collectors were trained on the contents of the checklist and the supervisor had provided onsite close supervision, technical support, and checked all filled checklists for completeness, accuracy, and consistency.

Data processing and analysis presentation: collected data were checked and entered into Epi-Data manager 4.6 versions. Then, it was exported into and analyzed by SPSS 25 versions. Descriptive statistics were computed to summarize categorical variables of participants' baseline characteristics and fetal outcomes and complications of operative

deliveries. Fetal birth complications of operative delivery were dichotomized and analyzed using binary logistic regression. The model fitness was checked by the Hosmer-Lemeshow goodness of fit test. In the bivariate logistic regression, predictors with p-value <0.25 at 95%CI were candidates for multivariate logistic regression to compute the adjusted odds' ratio. In the multivariate logistic regression, predictors with a probability value of < 0.05 at 95%CI were considered statistically significant associations.

Ethical consideration:before starting data collection, ethical clearance approved by Jimma University Institutional review board (IRB) was given to Jimma University medical center administrator. Then, a support letter was obtained from Jimma University medical center administrator and given to the obstetric ward and operation room to collect the card number of the patients´ charts and to the card room to collect the main charts/cards of the patients from which data was collected. The patient´s name was not recorded on the checklist. Confidentiality of all the charts reviewed was highly maintained throughout the data collection of the research process. This study was conducted in accordance with the Declaration of Helsinki. The patient informed consent was waived by Jimma University IRB due to the anonymized data.

Results

Socio-demographic and baseline characteristics of the participants:a total of 300 study participants were included in this study, with a completion rate of 98.7%. More than two-third, 232(77.3%), of the mothers were aged <35 years. Concerning residence area, the majority, 224 (74.8%), lived in rural areas, whereas the rest resided in urban areas. Among the study participants, 140 (46.7%) of them were primiparous while 74 (24.6%) of the mothers had more than four parties. Concerning antenatal care (ANC) follow-up status, only 201 (66.9%) of them had at least one ANC follow-up. Among mothers who were undergoing operative delivery, 228 (76%) of them were term, however, 54 (18.0%) of them were preterm. The majority, 282 (94%), of study participants hadn't been diagnosed with medical illness (Table 1).

Obstetrics characteristics of the participants: the majority, 276 (92.1%), of the newborn were alive during discharge and a large number, 248 (82.6%), of the newborns had an APGAR (appearance, pulse, grimace, activity, and respiration) score of 7-10 at the fifth minute. Most, 255 (84.9%), of newborns weighed 2.5-4 kg at birth. Regarding fetal and maternal outcomes, 24 (7.9%) and 2(0.7%) died, respectively. The highest, 13 (54.2%), magnitude of fetal death was recorded among mothers delivered by vacuum-assisted delivery. Around two-third, 195 (65%), of mothers were delivered by cesarean section, followed by assisted forceps delivery 89 (29.6%), while assisted vacuum delivery was the least, 16 (5.4%), a procedure performed. From operated CS cases, 185 (94.7%) were emergency and only 10 (5.3%) were elective (Table 2).

Neonatal complications: among mothers delivered by operative delivery, 105 (35.0%) developed neonatal birth complications. The commonest neonatal complication was minor scalp laceration (bruising) which accounts for 86 (28.8%) followed by cephalic hematoma, 6 (2.0%) (Table 3).

Factors associated with fetal birth complications of operative deliveries: the outcome variables were dichotomized into presence and absence of complication, and then it was analyzed by binary logistic regression. In bivariate logistic regression, a predictor variable having a p-value < 0.25 was a candidate for multivariate logistic regression analysis to compute the adjusted odds' ratio at a confidence level of 95%. In bivariate logistic regression, predictor variables like age, parity, types of operative deliveries, fetal weight at birth, and fetal outcomes were factors associated with neonatal complications. Whereas predictors such as study participant's residence area, ANC follow up, presence of medical illness, and the maternal outcome had no association with fetal birth complications (Table 4). Based on multivariate

logistic regression, a mother aged ≥35 years was 1.91 times more likely to develop neonatal complications than those aged less than 35 years, (AOR=1.91, 95% CI: (1.31,4.73)). Furthermore, those neonates delivered by forceps were 5 times more likely to develop fetal complications than those delivered by cesarean section delivery, (AOR=4.70, 95% CI: (1.43, 11.31)), and over-weighted fetal had more likely to develop fetal complications than those who had normal birth weight, (AOR=2.56, 95% CI: (1.44, 10.91)) (Table 4).

Discussion

Even though childbirth is a normal process, during complications of labor operative deliveries are conducted. Each operative delivery could have different fetal outcomes. Obstetric care should be to reduce the risk of maternal and fetal morbidity and, where morbidity occurs, minimize the likelihood of serious harm while maximizing maternal choice [10,20]. So, this study was aimed to identify fetal outcomes among mothers who gave birth through operative deliveries. This study shows that 2 (0.7%) and 24 (7.9%) of maternal and neonatal deaths respectively among mothers who were delivered by operative deliveries. This finding was almost similar, 17 (0.6%), in maternal and lower half in neonatal mortality, 506 (17.8%), with a study conducted in Tigray [21]. However, the mortality recorded in our study finding was lower than the study conducted in Jimma which shows, 6 (17.6%) of neonates died among mothers who gave birth by assisted instrumental delivery [19]. The possible reason for this inconsistency was our study included fetal outcomes of cesarean section delivery while the previous study only studied fetal outcomes of operative vaginal deliveries. Additionally, neonatal mortality recorded in Italy in 2015 due to operatively delivery was lower, 23 (0.87%), than our study finding [3]. This incongruence might be due to health care accessibility and quality of care among low-income and developed countries.

This study outlined that laceration (bruising) was the commonest, 86 (28.8%), complications of operative deliveries, and those deliveries assisted by forceps had more neonatal complications than vacuum-assisted deliveries, 63 (60.0%), versus 3 (2.9%), neonatal complications. However, vacuum-assisted delivery had a higher death rate relative to forceps-assisted deliveries. This study finding was consistent with a review article which revealed, neonates who are delivered by forceps do tend to be at an increased risk for minor facial abrasions and facial nerve palsies [2]. Furthermore, this study finding was relatively consistent with a study conducted in India which spectacles, neonatal bruising occurs due to operative deliveries accounting 29% [22]. Additionally, the study conducted in Portugal supported this study finding which shows neonatal mortality associated with vacuum-assisted delivery was higher than forceps-assisted delivery [23]. This consistency shows that there is a universal similarity associated with forceps assisted delivery between high and low-income countries.

On the other hand, neonatal birth injuries were higher in the study conducted in Ethiopia among mothers who gave birth by operative vaginal deliveries, 15 (44.1%) [19]. Additionally, our study finding was inconsistent with the study conducted in Istanbul which revealed neonatal birth injury between forceps and vacuum-assisted deliveries were almost similar [7]. It was also in contrast with another study finding which revealed, the incidence of fetal death from vacuum extraction is low, ranging from 0.1-3 cases per 1000 extraction procedures [24]. The inconsistency might be due to the existence of variation among the experience of the obstetrician who conducted the delivery. Based on multivariate logistic regression, a mother was aged ≥35 years was 1.91 times more likely to develop neonatal complications than those aged less than 35 years, (AOR =1.91, 95% CI: (1.31, 4.73)). Furthermore, those neonates who delivered by forceps were 5 times more likely to develop fetal complications than those delivered by cesarean section delivery, (AOR=4.70, 95% CI: (1.43, 11.31)), and over-weighted fetal had more likely to develop

fetal complications than those who had normal birth weight, (AOR=2.56, 95% CI: (1.44, 10.91)) whereas other variables were not associated with neonatal birth complications. Our study finding was consistent with a study conducted in France which reveals, forceps delivery was associated with a significantly higher neonatal complication (P<0.001) [25]. Additionally, there is a similarity of our study finding with the study conducted in Australia which shows, there is a significant association between neonatal birth weight and fetal birth complications (p<0.001) [1]. Another study also shows, there is a significant association between fetal birth complication and fetal weight at birth (p = 0.046) [4].

On contrary, a study conducted in India shows, no statistically significant neonatal morbidity difference was noted among types of operative delivery [22]. Other study shows, there was no significant difference in terms of maternal land neonatal morbidities among neonates who delivered by OPV [7]. Other study also revealed, compared to forceps assisted delivery, vacuum delivery was associated with a higher incidence of soft tissue trauma (AOR, 2.1; CI 95% P = 0.004) [23]. Besides, another study revealed, the risk of maternal mortality did not differ significantly between CS and operative vaginal delivery (OR=1.2 [0.76-2.04]) [26]. Furthermore, our study finding was inconsistent with other studies [3,11,27]. This discrepancy might be due to labor management-related factors among obstetricians among facilities and countries.

Strengths and limitations of the study: this study attempted to add fetal morbidity and mortality due to cesarean section delivery in addition to operative vaginal delivery, and tried to show the risk and benefit of each type of operative delivery. Different types of operative deliveries might have been performed, even to conduct one delivery which might cause bias even though it was not documented on the participant's chart. Fetal birth complications might be affected by early intervention and the experience of obstetricians who conduct the delivery.

Conclusion

The magnitude of fetal birth complications due to operative delivery was high. Scalp laceration or bruising and cephalic hematoma were the common complications due to operative deliveries. Age of mother, types of operative delivery, and fetal birth weight were predictors of neonatal complications among operatively delivered neonates.

What is known about this topic

- *The commonest neonatal complication was minor scalp laceration (bruising);*
- *A mother aged ≥35 years was more likely to develop neonatal complications than those aged less than 35 years;*
- *A neonate delivered by forceps was more likely to develop fetal complications than those delivered by cesarean section.*

What this study adds

- *The maternal outcome had no association with fetal birth complications;*
- *The proportion of neonatal complications due to operative deliveries was high;*
- *The highest magnitude of fetal death was recorded among mothers delivered by vacuum-assisted delivery.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Abdata Workina wrote the conceptualization and original draft, Asaminew Habtamu and Ayele Fikadu wrote the literature review, methods and result section and Hailu Asmera wrote the discussion and conclusion part. All authors reviewed and finalized the manuscript. All the authors have also read and agreed to the final manuscript.

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Tables

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Table 4: bivariate and multivariate logistic regression of neonatal outcomes of operative deliveries in JMC May 30, 2020, to May 30, 2021

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Table 1: socio-demographic and baseline characteristics of the participants in JMC from May 30, 2020, to May 30, 2021(n=300)

Variables	Categories	Frequency (n=300)	Percent (100%)
Age	Age <35	232	77.3
	Age≥35	68	22.7
Residence	Urban	76	25.2
	Rural	224	74.8
Parity	I	140	46.7
	II-IV	86	28.7
	>IV	74	24.6
ANC follow up	Yes	201	66.9
	No	99	33.1
Gestational age in weeks.	<37wks	54	18.0
	37-42wks	228	76.0
	>42wks	18	6.0
Presence of medical illness	Yes	18	6.0
	No	282	94.0

JMC: Jimma medical center

Table 2: obstetrics characteristics of the participants in JMC from May 30, 2020, to May 30, 2021

Variables	Categories	Frequency (n=300)	Percent (100%)

Types of operative delivery	CS	195	65.0
	Forceps	89	29.6
	Vacuum	16	5.4
Fetal death respective with types of operative deliveries	Vacuum deliveries	13	54.2
	Cesarean section	7	29.2
	Forceps	4	16.6
Circumstance of CS	Elective	10	5.3
	Emergency	185	94.7
Frequency of CS	Primary	173	88.8
	Repeat	22	11.2
Length of hospital stay after CS	<5 days	118	60.7
	5-7 days	59	30.1
	>7 days	18	9.2
Sex of neonate	Male	114	37.9
	Female	186	62.1
Types of anesthesia for CS	GA	169	86.9
	SA	26	13.1
Fetal weight in grams	<2.5	29	9.8
	2.5-4	255	84.9
	>4	16	5.4
Fifth minute APGAR score	0-3	17	5.7
	4-6	35	11.7
	7-10	248	82.6
Maternal outcome	Alive	298	99.3
	Died	2	0.7
Fetal outcome	Alive	276	92.1
	Died	24	7.9
GA; General anesthesia, SA; Spinal anesthesia, CS; Cesarean section, JMC: Jimma medical center, APGAR; appearance, pulse, grimace, activity, and respiration			

Table 3: types of neonatal complications of neonates who delivered by operative deliveries at JMC from May 30, 2020, to May 30, 2021

Variables		**Frequency**	**Percent (%)**
Neonatal complications	Yes	105	35.0

	No	195	65.0
Types of neonatal complications(n=105)	Minor scalp laceration or bruising	86	28.7
	Cephalic hematoma	6	2.0
	Facial palsy	3	1.0
	Skull fracture	5	1.7
	Others*	5	1.7
Note: *unexplained convulsions, neonatal jaundice, and birth asphyxia, JMC; Jimma medical center			

Table 4: bivariate and multivariate logistic regression of neonatal outcomes of operative deliveries in JMC May 30, 2020, to May 30, 2021

Variables	**Categories**	**Presence of complication**		**P-value**	**COR (95% C.I.)**	**AOR (95% C.I.)**
		Yes	No			
Age in years	Age <35	68	164	.013*	1.00	1.00
	Age≥35	37	31		2.88(1.65, 5.01)	1.91(1.31,4.73)
Residence	Urban	24	52	.469	1.00	
	Rural	81	143		1.22(0.70, 2.14)	
Parity	I	48	92	.038	0.61(0.35, 1.09)	
	II-IV	23	63		0.43(0.22, 0.83)	
	>IV	34	40		1.00	
ANC follow up	Yes	74	127	.347	1.28(0.77, 2.13)	
	No	31	68		1.00	
Presence of medical Illness	Yes	7	11	.721	1.19(0.45, 3.18)	
	No	98	184		1.00	
Types of operative delivery	CS	39	156	0.001*	1.00	1.00
	Forceps	63	26		9.69(5.45, 17.24)	4.70(1.43,11.31)
	Vacuum	3	13		0.92(0.25, 3.4)	0.41(0.08, 0.89)
Fetal weight in grams	<2.5	10	19	0.035*	1.09 (0.49, 2.45)	1.40(1.04, 5.37)
	2.5-4	93	162		1.00	1.00
	>4	2	14		4.01(0.89, 18.07)	2.56(1.44,10.91)
Fifth minute APGAR score	0-3	5	12	.392	0.72(0.25, 2.11)	
	4-6	9	26		0.6(0.27, 1.33)	
	7-10	91	157		1.00	
Maternal outcome	Alive	104	194	.655	0.54(0.03, 8.66)	
	Died	1	1		1.00	
Fetal outcome	Alive	87	189	.001	0.15(0.06, 0.4)	
	Died	18	6		1.00	

Note: *p-value <0.05 in multivariate logistic regression. COR, crude odds ratio; AOR, adjusted odds ratio; CI confidence interval; ANC, antenatal care; APGAR, appearance, pulse, grimace, activity, and respiration; CS, cesarean section; JMC, Jimma medical center