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Maternal and Neonatal Outcomes of Operative Vaginal Deliveries at a Single Tertiary Center

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ABSTRACT

Objectives: Our study sought to assess the maternal and neonatal outcomes of operative vaginal deliveries (OVDs) at Sultan Qaboos University Hospital (SQUH). We assessed the proportion of OVDs along with the proportion of maternal and neonatal outcomes of kiwi OmniCup vacuum, metal cup vacuum, and forceps deliveries. ***Methods***: We conducted a retrospective cohort study in the Obstetrics and Gynecology Department at SQUH from June 2015 to March 2018. The hospital information system was utilized to obtain records of all women who delivered at SQUH by vacuum or forceps during the study period. We collected data on maternal demographics, maternal and neonatal outcomes, and total number of deliveries. ***Results:*** During the study period, 3.8% of deliveries were OVDs. The most common instrument used was the Kiwi OmniCup vacuum device. No significant difference was found between the type of tears and instrument used except perineal tears ($p = 0.003$), which was seen more in the vacuum group, particularly Kiwi OmniCup. Neonatal birth weight ($p = 0.046$) was significantly higher in the metallic vacuum cup group. Thirty-one neonates (6.6%) were admitted to the neonatal intensive care unit, and most were born using Kiwi OmniCup vacuum (67.7%). ***Conclusions:*** OVD is an ideal alternative to cesarean section with fewer maternal and neonatal complications in women who cannot deliver spontaneously if performed by a well-trained obstetrician.

Operative or assisted vaginal delivery (OVD) is a vaginal birth in which an instrument is needed to facilitate the delivery and is accomplished using a vacuum device or forceps.[1] Over 700 different types of obstetrical forceps have been known so far in history.[2] Both vacuum and forceps deliveries require a skilled and experienced obstetrician.

There are various types of vacuums available. However, in Sultan Qaboos University Hospital (SQUH) only two types are used. One is the plastic Kiwi OmniCup, and the second is a metal cup.[2] Moreover, outlet forceps are the main type of forceps used. The indications for application are similar for both instruments and are categorized as either for fetal indications (mainly non-reassuring fetal status) or maternal indications, including poor maternal effort and medical conditions that require shortening of the second stage of labor (e.g., cardiac diseases).[3]

Internationally, modern obstetric practice has witnessed an increased rate of cesarean section (CS) with high concerns. It carries risks to both the woman and her baby, especially if it is performed during the second stage of labor, resulting in complications in future pregnancies such as an increased risk of preterm birth or miscarriage.[4] This increase is multifactorial but mainly attributed to failed operative deliveries due to lack of clinical experience and training and lack of support from senior obstetricians.[5] Other factors include increasing maternal age and nulliparous deliveries.[5] In the UK, the CS rate has doubled from 1990 to 2008, whereas in the USA, CS accounts for one-third of total births. Therefore, the American College of Obstetricians and Gynecologists recommends training for all obstetricians in instrumental deliveries to control and reduce the rates of CS.[6]

The recent trend of reduced training hours in obstetrical care has resulted in less exposure and

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experience in dealing with complicated vaginal deliveries. This resulted in increased CS rates.[7] This trend is also noted in various institutions in Oman and increased CS rates due to various reasons, including medico-legal concerns. The risk of death in urgent births was calculated at 0.8 per 1000 births for emergency CS, whereas the vacuum and forceps births carried a risk of 0.5 and 0.6 per 1000, respectively.[6] Moreover, the prevalence of neonatal complications in instrumental delivery is higher than that observed with spontaneous vaginal delivery.[8,9] Neonates born by forceps and vacuum delivery have an approximately fourfold and threefold higher birth trauma rate, respectively, compared with those born by spontaneous vaginal delivery.[10] These complications can be reduced if the procedure is performed by a skilled operator, thus reducing the risk for women and their babies from CS, especially in the second stage of labor.[11]

Literature review demonstrates that forceps and vacuum have been compared in several studies. Different maternal and neonatal outcomes and complication rates between the two methods have been studied.[12]

The relative risks and benefits of vacuum and forceps have also been evaluated in a systematic review. However, there is insufficient data regarding optimal instrument placement and the potential morbidity associated with suboptimal placement.[13] In addition, the obtainable data from the published controlled trials cannot be analyzed separately to compare vacuum and forceps in their use for rotational deliveries.[3]

In Oman, there is a lack of data on the incidence and outcomes of OVDs. Thus, this retrospective study was conducted at SQUH, a tertiary care center, an undergraduate and postgraduate teaching hospital with 4000 to 5000 deliveries per year. We aimed to determine the incidence and share our experience with OVD, thus providing obstetricians with an insight into the importance of effective care for pregnant women during delivery. In addition, the results of such a study will assist in providing clear recommendations for the optimum use of OVD, thus reducing risks and complications. Hopefully, this will increase the awareness of the need for more structured training and simulation activities to train our junior staff and trainees.

The primary objective of our study was to determine the incidence and maternal and neonatal outcomes of OVDs at SQUH. Our secondary objective was to assess the maternal and neonatal outcomes of Kiwi OmniCup vacuum compared to metal cup vacuum and forceps deliveries.

METHODS

We conducted a retrospective cohort study in the Department of Obstetrics and Gynecology at SQUH from June 2015 to March 2018. The study was approved by the Research Ethics Committee of the College of Medicine and Health Sciences at Sultan Qaboos University (MREC # 1531) to collect patient data from the delivery ward and neonatal unit registries and hospital information system (TrakCare).

All women who delivered at SQUH by vacuum or forceps during the study period were included. Women with missing data and failed procedures were excluded from the study. The sample size was calculated based on the estimation of grade 3 to 4 perineal tear rate of 20% and was sufficiently powered (confidence interval of 99%). We got 411 patients, and added 15% to accommodate for dropouts. There were no dropouts in this study. The following data was collected:

1. Maternal demographics: age, body mass index (BMI), gravidity, parity, and medical and cesarean history.
2. Delivery details: gestational age at delivery, type of instrument used, and indication for OVD.
3. Maternal outcomes: estimated blood loss (EBL), episiotomy, and tears (perineal, cervical, and vaginal tears).
4. Neonatal outcomes: birth weight, Apgar scores at one and five minutes, cord pH, admission to neonatal intensive care unit (NICU), injuries, jaundice, and metabolic disorders (e.g., hypoglycemia).
5. Total number of births during the study period.

Database for the study sample was created in SPSS Statistics (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.).

Maternal demographic and delivery details are continuous variables; therefore, they were displayed as percentages using frequency tables and shown as mean (range)±standard deviation (SD) after their pattern of distribution was verified using the

Table 1: Maternal demographics for operative vaginal deliveries.

Characteristics	Kiwi OmniCup vacuum	Metallic vacuum	Forceps	*p*-value
Maternal age				0.093
Years (mean ± SD)	27.6 ± 4.3	28.3 ± 4.7	24.6 ± 5.1	
Gravidity				0.818
Primigravida	135	77	3	
Multigravida	138	85	2	
Parity				0.996
Nulliparous	159	94	3	
Multiparous	114	68	2	
Gestational age at delivery, weeks				0.001
< 37	18	3	2	
37–40	237	144	3	
> 40	18	15	0	
BMI, kg/m²*	28.1	29.3	30.1	0.103
Previous abortion				0.752
0	222	125	5	
1	35	22	0	
≥ 2	14	11	0	

SD: standard deviation.
**BMI: body mass index calculated for 443 due to missing data.*

one-sample Kolmogorov-Smirnov test (K-S test). Categorized variables of the above parameters, including medical and cesarean history, type of instrument used, station of the head, indication for OVD, and use of analgesia, were displayed by pie charts.

K-S test was used for categorized variables to verify the pattern of distribution. For testing the significance, several tests were used, including analysis of variance (ANOVA), chi-square test, and Fisher's exact test. For testing differences of means between more than two categorized variables and continuous variable with normal distribution as EBL ANOVA was used. While for testing the association between two categorized variables, the chi-square test was used, and for those with expected frequency less than five, Fisher's exact test was used. A *p*-value of 0.050 or less was considered significant.

Table 2: Indications for operative vaginal deliveries.

Indications	Kiwi OmniCup vacuum, n	Metallic vacuum, n	Forceps, n	Total, n	Percentage, %
Non-reassuring CTG	62	38	4	104	22.3
Poor maternal effort	33	30	0	63	13.5
Prolonged second stage	31	11	1	43	9.2
Fetal bradycardia	121	66	0	187	40.0
Fetal tachycardia	6	6	0	12	2.6
Fetal bradycardia with poor maternal effort	9	5	0	14	3.0
Shorten the second stage	2	0	0	2	0.4
Non-reassuring CTG with poor maternal effort	18	10	0	28	6.0
Prolonged second stage with non-reassuring CTG	9	5	0	14	3.0

CTG: cardiotocogram.

Table 3: Maternal outcomes of operative vaginal deliveries.

Maternal outcomes	Type of instrument, n (%)			Total	Percentage,%	*p*-value
	Kiwi OmniCup vacuum 291(62.3)	Metallic vacuum 171 (36.6)	Forceps 5 (1.1)			
EBL, mL, mean ± SD	366.2 ± 250.3	346.7 ± 169.1	320.0 ± 103.7	358.6 ± 222.9		0.522
Episiotomy						
Yes	73 (58.4)	51 (40.8)	1 (0.8)	125	26.8	0.522
Tears						
Type 1	49 (60.5)	29 (35.8)	3 (3.7)	81	17.3	0.003
Type 2	12 (52.2)	9 (39.1)	2 (8.7)	23	4.9	
Type 3	5 (50.0)	5 (50.0)	0 (0.0)	10	2.1	
Type 4	1 (100)	0 (0.0)	0 (0.0)	1	0.2	
Cervical	4 (80.0)	1 (20.0)	0 (0.0)	5	1.1	0.857
Vaginal	48 (96.0)	1 (2.0)	1 (2.0)	50	10.7	0.798

EBL: estimated blood loss; SD: standard deviation.
Data given as n (%) unless otherwise indicated.

RESULTS

During the study period, the total number of deliveries was 12 416 deliveries, out of which 467 were OVDs, accounting for 3.8% of deliveries.

The mean age of the women who delivered by Kiwi OmniCup vacuum, metallic cup vacuum, and forceps was 27.6, 28.3, and 24.6 years, respectively, with no statistical difference. There were no statistical differences noted in the mean gravidity, parity, and BMI in the three groups. Most women delivered between 37 and 40 weeks gestation, which was statistically significant in the three groups (p= 0.001) [Table 1]. The majority of women in the study presented without significant medical history (72.9%), while the most common medical history was diabetes seen in 17.5% of women. In addition, 86.7% were without previous history of cesarean delivery.

The most common indication for OVD was fetal bradycardia (40.0%), followed by non-reassuring cardiotocogram (CTG) (22.3%). Kiwi OmniCup and metallic cup were indicated mostly for fetal bradycardia, while most forceps deliveries were for non-reassuring CTG, as shown in Table 2.

Table 3 presents the main maternal outcomes. The highest mean for EBL was 366.2 mL and was noted with the use of Kiwi OmniCup vacuum. Episiotomy was performed in 26.8% of women. All types of perineal tears were noted more in women who had a vacuum than forceps delivery (p = 0.003). Cervical tears noted in 1.1% and vaginal tears noted in 10.7% of women with no differences noted with the type of instrument used.

The mean birth weight for neonates was 3.0 kg, and there was a significant difference between instruments used (p = 0.046) with the larger weight

Table 4: Neonatal outcomes of operative vaginal deliveries.

Outcomes	Kiwi OmniCup vacuum	Metallic vacuum	Forceps	Total	Percentage,%	*p*-value
BW, kg, mean ± SD	3.0 ± 0.5	3.1 ± 0.4	2.6 ± 0.6	3.0 ± 0.5		0.046
Admission to NICU	21 (67.7)	9 (29.0)	1 (03.2)	31	6.6	0.243
Jaundice	19 (59.4)	12 (37.5)	1 (3.0)	32	6.9	0.537
Injuries	11 (61.1)	6 (33.3)	1 (5.6)	18	3.9	0.177
Apgar score at one minute, mean ± SD	8.4 ± 1.3	8.4 ± 1.3	8.4 ± 0.9	8.4 ± 1.3		0.999
Apgar score at five minutes, mean ± SD	9.6 ± 0.7	9.7 ± 0.7	9.4 ± 0.9	9.6 ± 0.9		0.701

BW: birth weight; NICU: neonatal intensive care unit; SD: standard deviation.
Data given as n (%) unless otherwise indicated.

noted with metallic vacuum use [Table 4]. Thirty-one (6.6%) neonates were admitted to the NICU. Jaundice was present in 6.9% neonates. There were injuries in 18 neonates, which accounted for 3.9% of the total number of instrumental deliveries. The mean Apgar score at one minute was 8.4, while at five minutes was 9.6.

DISCUSSION

Birth rates by CS in recent years have risen throughout the world. OVD is important choice for decreasing birth rates by CS and its related morbidities.[14] The incidence of OVD at SQUH from June 2015 to March 2018 was 3.8% of total births. Based on the latest survey by the World Health Organization (WHO) regarding the method of delivery and pregnancy outcomes in nine Asian countries, including 107 950 births, 3.2% were by instrumental vaginal delivery procedures.[15] Therefore, the incidence of OVD in our study is considered comparable to nearby developing countries and within the worldwide incidence of 2–15%.[1] This trend may be due to its relative safety, less tendency to use CS, and increment in the number of skilled specialists. At SQUH, the rate of CS has been steady in the last few years (12–15%) due to regular audits for CS cases and training junior staff in OVDs.

In this study, the most instrument used was vacuum, specifically the Kiwi OmniCup, which was used for 291 women, followed by the metallic cup in 171 women. Forceps were the least used in only five women. A study in 2013 noted that vacuum extraction was popular in Africa and Asia, while forceps delivery was popular in Eastern Europe and South America.[16,17] However, the rate of vacuum has increased against forceps application in most centers worldwide.[12] This agreement can be explained by the recent evidence of decreased maternal trauma with vacuum deliveries compared to forceps deliveries in randomized trials and by the improvement in the technique of vacuum deliveries, especially in the material used for vacuum cups.[1]

Most women who had OVDs in our cohorts were young and overweight. Worldwide, the rate of CS and instrumental deliveries increased dramatically from 1978 to 2001, which was explained by the general increase of weight in the population, which resulted in an increased risk of gestational diabetes and other maternal morbidities.[18,19] Most of our women (72.9%) presented without significant medical history. However, 17.5% of women had diabetes which correlates with the high mean BMI and high incidence of diabetes in the society resulting in a higher risk of OVD.[17,20]

Fetal bradycardia and non-reassuring CTG were the most common indications for vacuum and forceps deliveries, respectively. Our results are consistent with published literature as for the last 15 years, the most frequent indication for OVD in modern obstetrics is fetal distress.[21,22]

EBL ranged between 100 to 2500 mL, with the highest noted using the Kiwi OmniCup vacuum. No significant difference was found between it and the instrument used. However, in a study conducted in Jinnah Hospital, they found a significant difference with the highest blood loss seen in the forceps group than in the vacuum group.[23] In this study, the incidence of forceps deliveries was very low. That could be due to a lack of experienced obstetricians in forceps deliveries, which might explain the difference in results.

We found no significant difference between the type of tears and instrument used except with perineal tears ($p = 0.003$). There was an association between the instrument used and the degree of perineal tears. The majority of tears presented in the Kiwi OmniCup vacuum group. Third- and fourth-degree perineal tears presented with the use of vacuum only. Our study is not consistent with the findings of other studies. For example, in the review of over 50 000 vaginal deliveries at the University of Miami, the rate of third and fourth perineal lacerations was significantly higher in forceps (20.0%) than vacuum deliveries (10.0%).[24] The difference can be explained by the low incidence of forceps deliveries in our study. However, in another study comparing the Kiwi OmniCup and metallic cup vacuum, there were no differences noted in the maternal and neonatal outcomes in both groups.[25]

Neonatal birth weight was larger in the vacuum group for both cups. In a study conducted in Uttarakhand, India, neonatal birth weight ranged between 2.5 kg to 3.0 kg, consistent with our findings.[1] Neonatal jaundice was noted in 32 infants (6.9%). In a study conducted at a tertiary hospital in Sion, Mumbai, with 299 cases, 20 neonates got jaundice.[26] The low incidence in our study could be explained by less neonatal complication rates,

skilled obstetricians, and good nutrition of women who regularly breastfed their infants. Eighteen neonates had injuries, mostly caput succedaneum, especially when applying the Kiwi OmniCup vacuum (61.1%). There was no significant difference between forceps and vacuum delivered groups in the incidence of superficial injuries. There was, however, a significantly increased incidence of caput and cephalhematoma in the vacuum delivered group compared with the forceps delivered group, similar to previous studies.[22,26] The findings in our study are explained by the mechanics of instruments used in which extrinsic pressure is applied to the fetal scalp and interstitial fluid accumulates to form the caput.

Our study is limited by its retrospective nature and being conducted in a single center, thus not representing the country population as a whole. Additionally, the small sample size might have affected the results.

Our study results can be used in counseling women who achieve full dilation at a low station but cannot deliver spontaneously. Moreover, this information can support the practice of OVD as an ideal alternative to immediate cesarean delivery from a low station; and thus, may help lower the rate of primary cesarean delivery. Further studies comparing OVD and CS at full dilatation are recommended.

CONCLUSION

OVDs should be performed by an experienced obstetrician for better perinatal outcomes. OVDs accounted for 3.8% of deliveries at SQUH and resulted in good outcomes. Though complications like perineal tears can be minimized, they cannot be completely controlled even in the most experienced hands. Most neonatal outcomes were similar in both types of instrumental deliveries. The instrument's safety depends mainly on the operator's skills and the correct selection of patients. Enhanced training of obstetricians in instrumental delivery may aid in further reducing the prevailing CS rates.

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