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Operative vaginal delivery: practice patterns and outcomes at a tertiary general hospital

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ABSTRACT

Introduction: There has been a global decrease in operative vaginal deliveries, with a marked shift towards the vacuum extractor. However, little is known about the trends in operative vaginal delivery in Singapore.

Methods: A retrospective study was conducted on all operative vaginal deliveries performed from 2012 to 2017 at Singapore General Hospital (SGH). Maternal outcomes in terms of postpartum haemorrhage and obstetric anal sphincter injuries were compared between forceps- and vacuum-assisted deliveries. Neonatal outcomes in terms of neonatal intensive care unit (NICU) admission and clinically significant neonatal events were compared. The instrument preference of obstetricians was analysed.

Results: A total of 906 consecutive operative vaginal deliveries were included in the study, comprising 461 forceps- and 445 vacuum-assisted deliveries. The rate of operative vaginal delivery was maintained at approximately 10% from 2012 to 2017. Neonatal cephalohematomas were more common after vacuum-assisted deliveries. Other maternal and neonatal outcomes did not differ significantly between the two groups. Clinically significant neonatal events were mostly due to shoulder dystocia, whereas all cases of NICU admissions were not directly related to the mode of delivery. Obstetricians' choice of instrument appeared to reflect personal preference and was not affected by the year of graduation.

Conclusion: The rates of neonatal and maternal morbidity were low at SGH. Overall instrument use of forceps and vacuum was balanced, and proficiency in both was demonstrated by all operators. Operative vaginal delivery remains an essential skill in facilitating safe vaginal delivery, which should be maintained to keep Caesarean section rates in check.

Keywords: obstetric delivery, obstetric forceps, obstetric vacuum extraction, obstetric/instrumentation extraction, physicians' practice patterns

INTRODUCTION

Operative vaginal delivery is the use of the obstetric forceps and vacuum extractor to deliver the fetus in the second stage of labour. Proficiency in the use of these instruments has long been regarded as a training goal for obstetricians. These skills are often referred to as the epitome of the ‘art of obstetrics’, clinical skills that cannot be learnt in textbooks but are achieved after many hours of apprenticeship and experience.

There has been a decline in operative vaginal deliveries worldwide,⁽¹⁻⁴⁾ with a more significant decline in forceps deliveries compared with vacuum deliveries.⁽⁵⁾ In countries such as the United States (US), the rate of operative vaginal deliveries has dropped to 3.1%, and forceps deliveries make up just 1/4th of the total number of assisted vaginal deliveries.⁽⁶⁾ In the United Kingdom (UK), operative vaginal delivery rates have remained comparatively more stable between 10% and 15%, with a more balanced use of each instrument.⁽⁷⁾ The decrease in operative vaginal deliveries may be attributed to medicolegal implications,⁽⁸⁾ declining competency in performing assisted vaginal delivery⁽⁹⁾ after reduced training opportunities,⁽¹⁰⁾ and both patient and provider concerns about their safety and efficacy. Both vacuum- and forceps-assisted deliveries carry a small risk of clinically significant neonatal injuries. Forceps-assisted deliveries are linked to higher rates of obstetric anal sphincter injuries (OASIS) and pelvic floor trauma,⁽¹¹⁾ whereas vacuum-assisted deliveries show higher failure rates in delivering the fetus.⁽²⁾ These factors may play a part in explaining operators’ reluctance to perform operative vaginal delivery, particularly forceps-assisted deliveries.

This decrease in operative vaginal delivery rates has been accompanied by a corresponding increase in Caesarean section rates. Caesarean section has an increased risk of intraoperative complications, excessive blood loss, febrile morbidity and neonatal respiratory problems.⁽¹²⁾ Appropriately performed operative vaginal deliveries have shown lower maternal morbidity compared with Caesarean section, without increased neonatal morbidity. The use of

forceps or the vacuum extractor can safely assist in vaginal delivery and reduce routine conversion to Caesarean section in the second stage of labour.⁽¹³⁾ This is particularly relevant as Caesarean section in the second stage of labour carries greater maternal risks, such as major haemorrhage and bladder trauma, and infants may suffer more frequently from perinatal asphyxia.⁽¹⁴⁾

Practice patterns and outcomes of operative vaginal delivery have been reported in Europe⁽¹⁵⁾ and the US,⁽²⁾ but research in this area is limited in Asia. It is not known if the trend in operative vaginal deliveries in Asia mirrors the decline in other parts of the world, with a shift away from the forceps extractor, and whether neonatal and maternal outcomes differ between instruments. Hence, a review of current trends and outcomes of vacuum versus forceps vaginal delivery in a Singapore tertiary general hospital is warranted to elucidate the reasons governing instrument preference.

This study aimed to determine the trend in operative vaginal deliveries at Singapore General Hospital (SGH) over a six-year period, to compare delivery-related maternal and neonatal morbidity between vacuum and forceps delivery and to analyse obstetricians' preferences in instrument usage. We also attempted to compare the operative vaginal delivery rates in our institution with published national rates in the UK and the US.

METHODS

A six-year retrospective study was conducted on all operative vaginal deliveries performed between 2012 and 2017 at SGH. This retrospective study was reviewed and approved by the SingHealth Centralised Institutional Review Board of Singapore. One of the authors, VRYZ, collected data on 906 consecutive operative vaginal deliveries performed from 2012 to 2017 across a one-year period in 2019. Maternal data, neonatal data and the name of the obstetrician performing the delivery were collected via paper records from the delivery suite database and

cross-checked against electronic records. Operative vaginal deliveries were recorded in a book in the labour ward immediately after each delivery by the healthcare team caring for the patient. Cases with incomplete data were excluded for the purpose of this study. There are situations where operative vaginal deliveries are performed with a more senior obstetrician supervising a trainee. In such deliveries, the more senior obstetrician's choice of instrument would govern the mode of delivery; therefore, in our study, we recorded the more senior obstetrician as the operator when two doctors had jointly performed a delivery.

Maternal outcomes were extracted from the database. Postpartum haemorrhage (PPH) was defined as the loss of 500 mL or more blood from the genital tract within 24 hours of the birth of a baby. OASIS encompassed both third- and fourth-degree perineal tears.

We reviewed neonatal outcomes, including neonatal intensive care unit (NICU) admission and clinically significant neonatal events comprising both instrument and non-instrument-related injuries. Another author, PEE, extracted specific neonatal outcomes from the neonatal database, Research Electronic Data Capture (REDCap®), from August 2012 to October 2017. The total operative vaginal delivery rate and Caesarean section rate at SGH across 2012–2017 was calculated and compared with the rates in the UK and the US across a similar time period.

IBM SPSS Statistics version 24.0 (IBM Corp, Armonk, NY, USA) was used to examine the associations between selected variables via Pearson's chi-square tests.

RESULTS

We included 906 cases of operative vaginal delivery from 2012 to 2017, including 461 forceps-assisted deliveries and 445 vacuum-assisted deliveries.

Table I shows the operative vaginal delivery rate and Caesarean delivery rate at SGH from 2012 to 2017. With the exception of 2012, the operative vaginal delivery rate was

approximately 10%. Both forceps and vacuum deliveries are common at SGH, with neither instrument being strongly preferred.

Table I. Operative vaginal delivery rates at Singapore General Hospital.

Type of delivery	Year					
	2012	2013	2014	2015	2016	2017
Operative vaginal delivery rate (%)	6.3	9.7	10.1	10.0	9.6	9.6
Forceps	58	83	92	99	63	76
Vacuum	40	62	78	82	107	78
Caesarean section rate (%)	36.2	31.9	36.9	35.5	37.3	35.8

Table II shows the maternal outcomes for women who underwent operative vaginal deliveries. It is noted that the prevalence of OASIS in forceps deliveries is higher than that in vacuum deliveries, but this is not statistically significant.

Table II. Maternal outcomes and operative vaginal delivery.

Outcomes	No. (%) / Mean \pm standard deviation		p-value
	Forceps (n = 461)	Vacuum (n = 445)	
Age (yr)	30.5 \pm 4.5	30.1 \pm 4.3	0.127
Median parity	0	0	0.173
Gestation (wk)	39.1 \pm 1.4	39.2 \pm 1.1	0.392
Postpartum haemorrhage	21 (4.6)	17 (3.8)	0.581
Blood loss in women with PPH (mL)	644 \pm 200	638 \pm 257	0.931
Obstetric anal sphincter injuries	21 (4.6)	11 (2.5)	0.092

PPH: postpartum haemorrhage

Table III shows the outcomes in infants delivered by operative vaginal delivery. Infants delivered by either instrument were similar in birthweight. There were similar numbers of clinically significant neonatal events as well as NICU admissions in both forceps and vacuum

deliveries. Most of the clinically significant neonatal events were cases of shoulder dystocia. The rate of neonatal cephalohematomas was higher in babies undergoing vacuum delivery (5.2% compared with 1.7%, $p = 0.0045$), as was the rate of shoulder dystocia (2.2% vs. 1.3%, $p = 0.28$), although this was not statistically significant. Under the forceps group, one infant had shoulder dystocia at birth requiring specialised manoeuvres such as the McRobert's manoeuvre and delivery of the posterior arm to complete the delivery. Hence, he sustained a fractured humerus during an attempt to deliver the posterior arm, an accepted manoeuvre to overcome shoulder dystocia. This injury recovered with conservative management, with no longer-term sequelae. It is notable that this injury was a consequence of shoulder dystocia occurring after delivery and not directly attributable to the use of the instrument. Our series includes six cases of sequential use of instruments, where vacuum use was followed by forceps. These were classified as forceps-assisted deliveries to reflect the instrument that resulted in a successful delivery. In all six cases, there was no maternal morbidity in the form of PPH or OASIS, as well as no clinically significant neonatal event or NICU admission.

Table III. Neonatal outcomes and operative vaginal delivery.

Outcomes	No. (%)		p-value
	Forceps (n = 461)	Vacuum (n = 445)	
Birthweight (g)	3,118 ± 446	3,152 ± 404	0.373
NICU admission, No. (%)	20 (4.3%)	24 (5.4%)	0.460
Length of NICU stay (day)	2.0	1.4	0.112
Clinically significant neonatal events	10 (2.2%)	13 (2.9%)	0.472
Shoulder dystocia	6 (1.3%)	10 (2.2%)	0.282
Fracture	2 (1 clavicle, 1 humerus)	1 (clavicle)	0.584
Intubation	2	2	0.972
Cephalohematoma	8 (1.7%)	23 (5.2%)	0.005
Sequential use of instruments*	6 (no clinically significant events)		

**Vacuum first, followed by forceps. NICU: neonatal intensive care unit*

Table IV shows the indications for NICU admission, which are mostly that of transient tachypnoea of the newborns and other benign respiratory conditions of neonatal transition.

There were two infants in each group who required intubation and mechanical ventilation, whereas the others required continuous positive airway pressure or less invasive forms of respiratory support.

Table IV. NICU indications in operative vaginal delivery.

Indication	No.*	
	Forceps (n = 20)	Vacuum (n = 24)
Transient tachypnoea of newborn	13	15
Congenital pneumonia	3	2
Pneumothorax	2	4
Meconium aspiration syndrome	0	3
Early neonatal sepsis	1	0
Perinatal depression	2	2
Mechanical ventilation	2	2

*More than one indication for NICU admission for some of the infants.

Tables V and VI show the individual operator preference for instrument based on the number of forceps and vacuum deliveries they had performed from 2012 to 2017, ranked in order of obstetrician seniority, as defined by year of graduation from medical school. We included operators who had performed at least ten operative vaginal deliveries over the study period.

Table V. Operative vaginal deliveries performed by Obstetricians 1–8.

Parameter	Obstetrician no.							
	1	2	3	4	5	6	7	8
Year of graduation	1978	1981	1989	1989	1989	1991	1992	1993
No. of operative vaginal deliveries	99	28	176	60	33	17	241	35
Forceps	96	20	21	11	17	14	156	23
Vacuum	3	8	155	49	16	3	85	12
Preference index	32	2.5	7.4	4.5	1.1	4.7	1.8	1.9
Preferred instrument	Forceps	Forceps	Vacuum	Vacuum	Forceps	Forceps	Forceps	Forceps

Degree of preference	Strong	Moderate	Strong	Strong	Mild	Strong	Mild	Mild
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Table VI. Operative vaginal deliveries performed by Obstetricians 9–15 and trainees.

Parameter	Obstetrician no.							Trainees
	9	10	11	12	13	14	15	
Year of graduation	1997	1998	2000	2000	2003	2006	2008	After 2008 (all trainees)
Number of operative vaginal deliveries	12	16	25	18	23	20	17	80
Forceps	2	14	9	6	7	18	7	38
Vacuum	10	2	16	12	16	2	10	42
Preference index	5.0	7.0	1.8	2.0	2.3	9.0	1.4	1.1
Preferred instrument	Vacuum	Forceps	Vacuum	Vacuum	Vacuum	Forceps	Vacuum	Vacuum
Degree of preference	Strong	Strong	Mild	Moderate	Moderate	Strong	Mild	Mild

We devised a ‘preference index’ (PI), i.e. the ratio of use of the preferred instrument to the alternative instrument, to grade the degree of preference each obstetrician had for their preferred instrument. A higher numerical score would indicate a stronger preference for one instrument. We classified the preference into mild (< 2.0), moderate (2.0–3.0) and strong (> 3.0). Seven obstetricians, namely Obstetricians 1, 3, 4, 6, 9, 10, and 14, showed a strong preference for one instrument. Six obstetricians, namely Obstetricians 5, 7, 8, 11, 15 and the trainee group, showed a mild preference for one instrument. The remaining three obstetricians showed a moderate preference. No obstetrician used one instrument exclusively.

DISCUSSION

Overall, the rates of postpartum haemorrhage and OASIS were low, and there were no significant differences in maternal outcomes for either instrument. Although there were more

cases of OASIS in forceps-assisted deliveries than in vacuum-assisted deliveries, the difference was not statistically significant (p -value > 0.05). As reported in previous studies, delivery by forceps and, to a lesser extent, vacuum delivery are associated with a higher risk of OASIS.⁽¹⁶⁾ Randomised trials generally report a higher risk of third- and fourth-degree lacerations with forceps compared with vacuum extraction.⁽¹⁷⁾

The overall neonatal outcomes across forceps- and vacuum-assisted vaginal delivery were similar, with comparable NICU admission rates for the two groups. Most of the indications for NICU admission were owing to respiratory pathologies such as transient tachypnoea of the newborn or congenital pneumonia with or without likely meconium aspiration. None of the indications were directly related to instrument use in delivery. Other studies report that NICU admission was more frequent in assisted vaginal deliveries compared with spontaneous deliveries.⁽¹⁸⁾ The higher NICU admission rate could reflect the indication for operative vaginal delivery in the course of labour rather than a direct effect of the instrument. A common indication for operative vaginal delivery in both our study and in the current literature is fetal compromise in the second stage of labour.⁽¹⁹⁾ The rates of cephalohematoma and shoulder dystocia (not statistically significant) were higher in vacuum-assisted deliveries, which corresponds to the current literature.⁽²⁰⁾ Neonatal cephalohematomas are clinically insignificant injuries that resolve spontaneously without any long-term sequelae.

Obstetricians often show a preference for one instrument over another. We studied this interesting aspect of operative vaginal delivery with the hypothesis that more senior obstetricians would favour use of the forceps. This is because the obstetric forceps was introduced into clinical practice earlier and was the preferred instrument in Singapore for much of the 20th century. We believed that obstetricians would be more likely to select an instrument they had been trained with, rather than pick up a new skill. However, our results suggest otherwise. The choice of instrument appears to be a reflection of personal preference and was

not affected by seniority as measured by the year of graduation. The degree of preference also differed greatly between obstetricians, as quantified by our preference index. The number of operative vaginal deliveries performed by each obstetrician varied widely. Obstetricians 1, 3 and 7 had performed a higher number of deliveries. This is a result of the clinical interests of specific operators, with maternal-fetal specialists spending more time in the delivery suite.

The number of operative vaginal deliveries conducted by trainees make up a small proportion of the total number of deliveries, as there are fewer situations where trainees are unsupervised in SGH. Obstetric consultants are on duty in the delivery suite during daylight hours from Monday to Friday, and the only times trainees are not directly supervised are during out-of-hours on weekdays and weekends.

The Royal College of Obstetricians and Gynaecologists (RCOG) Green-top Guideline states that obstetricians should be confident and competent in the use of both forceps and vacuum.⁽⁴⁾ The ideal choice of instrument in a given clinical situation would best be made after weighing the specific circumstances of each case against the risk of maternal or neonatal trauma. Other authors emphasise the role of operator training with both instruments.⁽¹⁷⁾ From our results, there is some evidence to suggest that vacuum-assisted deliveries are more often associated with cephalohematomas and shoulder dystocia, whereas forceps deliveries are more often associated with OASIS, although not all findings are statistically significant. As the use of both instruments is complementary, institutions should maintain a critical mass of obstetricians that can practice both, to preserve the use of both instruments. In SGH, each obstetrician demonstrated ability to use both instruments, although some obstetricians did show a clear preference for one instrument over the other.

The current worldwide trend in instrument use is skewed towards the vacuum extractor.⁽⁵⁾ This is not the case at SGH, where a more balanced use of each instrument is demonstrated. It is interesting to note that SGH trainees similarly show a rather balanced

instrument preference, as their preference index is 1.1. This ratio mirrors the overall ratio of forceps-to-vacuum in SGH. We believe this reflects the training environment that the trainee is exposed to. Trainees who have the opportunity to be supervised in either instrument are, thus, more likely to be proficient in the use of both instruments.

Table VII describes the operative vaginal delivery rates and Caesarean section rates in SGH in Singapore as against those in the UK⁽²¹⁾ and the US.⁽⁶⁾ The prevalence of forceps and vacuum use in SGH are almost equal. The operative vaginal delivery rate at SGH falls in between that of the other two and is more similar to that in the UK. The forceps delivery rate of SGH and UK are markedly higher than that of the US. Caesarean section rates in SGH as a single institution are higher than the overall rate in both the UK and the US. We believe this to be a reflection of the case-mix at SGH, which is a multispecialty tertiary referral unit. Many of our patients have associated medical or obstetric complications, for which Caesarean sections are frequently medically necessary. The maintenance of adequate operative vaginal delivery rates plays a pivotal role in providing a safe alternative to Caesarean section and allowing as many women as possible to have vaginal births. This is especially so at SGH where Caesarean section rates are intrinsically higher.

Table VII. Delivery rates across Singapore General Hospital (SGH), the United Kingdom (UK) and the United States (US).

Delivery rate	%		
	SGH* (n = 918)	UK† (n = 486,012)	US‡ (n = 382,704)
Operative vaginal delivery	9.3	12.8	3.2
Forceps	4.8	7.1	0.6
Vacuum	4.5	5.7	2.6
Caesarean section	35.7	27.1	32.3

*Singapore General Hospital delivery rate from 2012 to 2017. †UK NHS Maternity delivery rate from 2012 to 2018. ‡US National Vital Statistic Report delivery rate from 2013 to 2015.

In the six cases of sequential instrument use, no maternal or neonatal morbidity was recorded. The RCOG advises caution in sequential use of instruments, as the operator has to

balance the risks of a potentially complex Caesarean section in the second stage of labour with the increased risk of neonatal trauma associated with sequential instrument use.⁽⁴⁾

The strength of this study is that it is a study of current trends in forceps and vacuum extractor use in an Asian country and the only such study in Singapore in recent years. We believe that outcome data from our study will be a useful counselling tool for local obstetricians.

One limitation of our study is that although we were able to compare the outcomes between forceps and vacuum-assisted deliveries, we did not assess the differences in outcomes between operative vaginal deliveries and Caesarean section performed in the second stage of labour. This would form a more comprehensive overview of the considerations faced by an obstetrician in choosing the mode of delivery. We hope to study these aspects in the future. There was a lack of information about the occurrence of pelvic floor trauma (apart from OASIS), women's length of hospital stays and analgesia use, which would have contributed to a more meaningful discussion on maternal outcomes following instrumental delivery. We also recognise that this is a single-centre study and that the findings may not reflect the practice in other institutions.

Overall, the rates of adverse maternal and fetal outcomes with operative vaginal delivery at SGH were low. Neonatal and maternal complications were not directly related to the use of instruments. The choice of instrument is an interesting aspect of operative vaginal delivery. In our institution, this choice appears to be largely owing to personal preference. In particular, there is no clear association between the seniority of the obstetrician and the preferred instrument. Although clinicians in our institution often demonstrate a preference for one instrument over another, expertise in both forceps and vacuum is demonstrated by all. Continued training in operative vaginal delivery is a challenge in modern obstetrics owing to widespread deskilling and concerns about its safety and efficacy. In skilled hands, both forceps-

and vacuum-assisted deliveries are useful tools in the armamentarium of the obstetrician. There is robust clinical evidence to show that the risk of neonatal injuries, such as intracranial haemorrhage, in neonates delivered in the second stage of labour is the same irrespective of whether the delivery is spontaneous, by operative vaginal delivery or an emergency Caesarean section.⁽²²⁾ Emerging evidence suggests that fetal injuries, such as skull fractures, are more likely if a Caesarean section is attempted in place of operative vaginal delivery when the fetal head is deeply engaged in the maternal pelvis.⁽²³⁾ We believe that appropriate use of both the forceps and vacuum extractor is an essential skill that should be maintained to keep Caesarean section rates in check.

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