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ORIGINAL ARTICLE

A Prospective Randomized Study Comparing Maternal and Fetal Effects of Forceps Delivery and Vacuum Extraction

Shekhar Shashank · Rana Neena · Jaswal Ranbir Singh

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Abstract

Objective To compare maternal and neonatal effects of assisted vaginal delivery by forceps and vacuum extraction.

Methods A prospective randomized study. One hundred eligible women requiring assisted vaginal delivery in the second stage of labor were randomized to deliver by forceps or vacuum extraction.

Results All of those allocated to forceps delivery actually delivered with the allocated instrument (100 % delivery rate in forceps vs. 90 % in VE); however, maternal trauma (40 % in forceps vs. 10 % in VE, $p < 0.001$), use of analgesia ($p < 0.001$), and blood loss at delivery (234 ml in VE vs. 337 ml in forceps group, $p < 0.05$) were significantly less in the group allocated to deliver by vacuum extraction. Vacuum extraction, however, appears to predispose to an increase in neonatal jaundice and incidence of cephalhematoma. More serious neonatal morbidity was rare in both groups.

Conclusion Extrapolation of the data from the study reveals that there is a significant reduction in maternal injuries. However, vacuum extraction has the potential to injure babies more.

Keywords Vacuum extractor · Obstetric forceps · Comparative morbidity · Outcome

Shekhar S. (✉), Assistant Professor
Department of Obstetrics and Gynecology, Dr. Rajendra Prasad Govt. Medical College Tanda, Set No 27, Block E, Type IV, Kangra, Himachal Pradesh 176001, India
e-mail: longshanks28@gmail.com

Rana N., Formerly Associate Professor
Department of Obstetrics and Gynecology, Indira Gandhi Medical College Shimla, Shimla, HP, India

Jaswal R. S., Assistant Professor
Department of Pediatrics, Dr. Rajendra Prasad Govt. Medical College Tanda, Kangra, HP, India

Introduction

Millions of women worldwide require instrumental vaginal delivery every year. Obstetricians have vacuum extractor or obstetric forceps to choose from as instruments for assisted vaginal delivery. Myerscough [1] delineates the basic dissimilarity in the mechanics of head extraction by forceps and vacuum extractor. The author explains that with forceps, pulling force is applied at the base of skull, while with ventouse, extraction of the head is effected with scalp traction by suction. The choice between these two options has usually been based on tradition and training [2].

Despite being introduced more than half a century ago by Malmstrom (1954), the modern vacuum extractor took a lead over forceps for assisted vaginal delivery only recently [3] owing largely to a number of trials conducted during the last three decades. Most of these randomized and non-randomized trials comparing maternal and fetal effects of vacuum extractor and forceps delivery agree upon the maternal benefits of vacuum extractor over forceps, namely less maternal soft tissue trauma, decreased requirement of regional or general anesthesia, and decreased blood loss. However, it is interesting to note that the verdict of the very same trials regarding the fetal effects of vacuum extractor hangs finely in balance [4–14]. The debate continues with respect to the relative merits of each, in particular the neonatal outcome.

This study has been carried out to compare the maternal and neonatal outcomes of forceps delivery and forceps extraction.

Materials and Methods

One hundred eligible women in the second stage of labor requiring assisted vaginal delivery were recruited into the study. The patients eligible for inclusion in the study were those with singleton pregnancies, a cephalic presentation, and a gestation of at least 37 completed weeks and where instrumental assistance was required for delivery during the second stage of labor. As soon as a decision had been taken to intervene, a random treatment allocation to forceps or vacuum extractor was made by opening the top envelope in a box of serially numbered envelopes. Regardless of the ultimate mode of delivery, for the purpose of analysis, the women remained in the group to which they were originally allocated. The trial protocol was approved by the ethics committee of the institute.

The Bird modification of the Malmstrom instrument was used. The vacuum was provided by a suction pump. The pressure was directly taken to 0.6–0.8 kg/cm^2. Traction was always coordinated with the uterine contraction. Two successive detachments of the cup were allowed. Das variety of long curved forceps and Wrigley's outlet forceps were used.

Full details of the procedure were noted including time of application of the instrument, time of delivery, type of instrument used, number of pulls, number of detachments in case of ventouse, and analgesia/anesthesia given. The obstetrician delivering the patient made an immediate assessment of the degree of maternal trauma. The patient was examined again at discharge by the resident looking after the ward. The attending pediatrician documented the information about the baby's condition at birth and again at postnatal examination (between 24 and 48 h after birth).

Maternal outcome was judged from the following points: perineal tears, extension of the episiotomy, vaginal lacerations, cervical tears, or others. Maternal blood loss, which was measured in a kidney tray, was also assessed by the hemoglobin decrease on the first postpartum day below the value at admission—attributable to trauma or to other factors unrelated to the operation (uterine atony, retained products). The fetal outcome was judged from 1 to 5 min Apgar score, scalp lesions (chignon, abrasion, and cephalhematoma), facial injuries, jaundice (either clinically appreciable or serum billirubin level >6 mg/dl), nerve palsies, intracranial hemorrhage, and signs of cerebral irritation, fracture, and mortality. The 18 operators consisted of consultants, registrars, and 2nd year and 3rd year postgraduate students.

Statistical Methods

The statistical tools used to analyze the data were student's t test for continuous variables and χ^2 test for proportions. *P* value of <0.05 was considered significant.

Results

Characteristics of the women (age, parity, gestation age), their labors (duration of second stage), as well as the indication of delivery and preapplication station of the heads were comparable in two groups (Table 1). In the present study, non-reassuring fetal status was the commonest indication of instrumental delivery and most of the instrumental deliveries were done at +3 stations or below. The women in the forceps group took significantly less time to deliver than those in the VE group (3.62 min for VE vs. 5.36 min for forceps, $p < 0.05$) after application of the instrument.

Effectiveness of the Delivery Method

All of those allocated to forceps delivery actually delivered with the allocated instrument, whereas vacuum extraction was successful in 90 % (45) of the cases (Table 2). There

Table 1 Characteristics of the two study groups

Variables	Ventouse ($n = 50$)	Forceps ($n = 50$)
Age (years), mean (SD)	25.2 (5.8)	24.4 (5.6)
Gestational age (weeks), mean	39	38.6
Birth weight (kg), mean (SD)	2.9 (0.59)	2.86 (0.71)
Nulliparity, *n* (%)	32 (64)	39 (78)
Indication for delivery n (%)		
Fetal distress	37 (74)	31 (62)
Delayed second stage	7 (14)	8 (16)
To shorten second stage	4 (8)	6 (12)
Delay plus distress	2 (4)	5 (10)
Preapplication station of head n (%)		
+2	21 (42)	22 (44)
+3, + 4	29 (58)	28 (56)
Duration of second stage(min) Mean(SD)	58 (33.41)	61.5 (33.27)

Values are shown as mean, standard deviation (SD), or *n* (%) as appropriate

Table 2 Actual mode of delivery in the two groups

Mode of delivery	Ventouse ($n = 50$) No. (%)	Forceps ($n = 50$) No. (%)
Specified instrument	45 (90)	50 (100)
Other (forceps)	5 (10)	0
Other (ventouse)	0	0
Cesarean section	0	0
Spontaneous vaginal	1 (2)	0

Table 3 Analgesia for delivery in the two study groups

	Ventouse $n = 50$ No. (%)	Forceps $n = 50$ No. (%)	p value
None	3 (6)	0	
Perineal alone	44 (88)	24 (48)	<0.001
Perineal and pudendal	3 (6)	26 (52)	<0.001
Epidural or spinal	0	0	

were five unsuccessful vacuum extractions. Among the failures, one delivered spontaneously and four were delivered by forceps. No patient in the study underwent cesarean section. Exceeding the limits of two detachments was the cause of failure in four cases, whereas suction failure was responsible for one failure. On analyzing the data further, we noted that forceps deliveries were more often conducted by the registrar or a final year post graduate student; however, the use of vacuum extraction was evenly distributed among all the levels of operators. Of the five failures observed in the vacuum extractor group, four occurred in the subset of women in whom the junior most level of operator had applied the instrument. A lot of enthusiasm and a lack of experience might have contributed to the higher failure rate among the vacuum extractor group.

Maternal Analgesia and Trauma

The analgesia required for the delivery is shown in Table 3. The patterns of analgesia used differed significantly between the two study groups. Local perineal infiltration alone was used for the majority of vacuum extractions. Pudendal block with local infiltration was more commonly employed to facilitate delivery with forceps. Injuries sustained by the women in the two randomized groups are listed in Table 4. Women were more likely to have perineal, vaginal, and cervical trauma in the forceps group. Severe maternal soft tissue trauma (extension to fornix, 3rd degree perineal tear, cervical tear, and paraurethral tear) was seen in 10 % of the ventouse deliveries compared with 40 % of the forceps deliveries ($p < 0.001$).

Table 4 Maternal soft tissue trauma

Trauma	Ventouse ($n = 50$) No. (%)	Forceps ($n = 50$) No. (%)	
Intact perineum	3 (6)	0	
3rd degree perineal tear	0	2 (4)	
Extension in vagina	9 (18)	23 (46)	
Small extension	7 (14)	13 (26)	
High extension	2 (4)	10 (20)	
Vaginal lacerations	1 (2)	4 (8)	
Cervical tear	2 (4)	2 (4)	
Paraurethral tear	1 (2)	1 (2)	
Significant maternal trauma*	5 (10)	20 (40)	p value <0.001

* Extension to fornix, 3rd degree perineal tear, cervical tear and paraurethral tear

Table 5 Neonatal morbidity

	Ventouse $n = 50$ No. (%)	Forceps $n = 50$ No. (%)	X^2	p
Cephalhematoma	6 (12)	2 (4)	3.16	>0.05 NS
Jaundice	5 (10)	3 (6)	1.70	>0.05 NS
Facial palsy	0	1 (2)		
Mortality	1 (2)	–		

The estimated mean blood loss in the women delivered by vacuum extractor was significantly lesser than those delivered by forceps (234 vs. 337 ml, $p < 0.05$). However the average drop in hemoglobin at admission and a day after delivery was not statistically different among both groups (VE 0.86 g% and Forceps 1.02 g%).

Neonatal Morbidity

Neonatal morbidity is summarized in Table 5. Some markings of the baby's scalp were always present after vacuum extraction. Many of the babies born by forceps also had some markings. In both groups these marks generally disappeared quickly. Cephalhematoma was more common in babies delivered by vacuum extractor; however, the difference was not statistically significant. There were no significant differences between the groups in terms of proportions of babies with low apgar scores. Overall abrasions were more common after forceps delivery, but the majority of these were small and superficial. The incidence of jaundice was more in the vacuum extractor group than in the forceps group (10 % in VE and 6 % in forceps, $p > 0.05$). The only neonatal death occurred in the vacuum extractor group. The woman was admitted in the second stage of labor with profound fetal bradycardia.

The random allocation was to vacuum extraction and she delivered promptly without detachment of the vacuum extractor. The placenta had separated prematurely and was delivered with the baby. The baby was severely asphyxiated and vigorous resuscitation was done, but the baby died after 6 h.

Discussion

Extrapolation of the data in our study substantiates the generally recognized observation that the vacuum extractor is safer for the mother as compared with delivery by forceps. There are clear differences between the two groups in the extent of maternal trauma, a finding which mirrors decades of observational data [4–14]. In particular, high extensions of episiotomy and tear of the anal sphincter were associated with forceps delivery. A clear superiority of vacuum extraction is the markedly reduced requirement for analgesia. This is attributable to the fact that the vacuum extractor cup does not occupy additional space between the fetal head and the birth canal and thus does not impinge on maternal soft tissue, causing minimal discomfort. The women delivered by vacuum extraction had significantly less blood loss compared to those delivered by forceps. It might be argued by the reader that knowledge of the allocated instrument might have biased the assessment of blood loss. We agree that even though estimation of blood loss at delivery is erroneous and difficult, this should not have led to a comparison bias.

The vacuum extractor is more likely to fail than the forceps. A number of factors, faulty technique, suction failure, and a fact weighing constantly on the mind of the operator that he or she cannot pull as hard as possible with this instrument or else the cup will detach, might be responsible for failure with vacuum extraction. No women in the study underwent cesarean section after failed attempt at assisted vaginal delivery. This is probably due to the reason that we strictly kept to the recommended indications for instrumental delivery and any women not meeting the criteria were delivered by cesarean section and not included in the study. On analyzing the data further, we noted that forceps deliveries were more often conducted by an experienced operator and these included four women in whom an earlier attempt by a less experienced operator with vacuum extractor had failed.

A review of the literature yields divergent views about the effects of vacuum extraction on the newborn. However, most authors agree that serious neonatal injuries are rare with vacuum extraction [6–8, 10, 12]. Neonatal well-being assessed by Apgar scores was no different among the two groups, consistent with other reports [4–6, 9, 10]. We observed a higher rate of cephalhematoma and jaundice with vacuum extraction in our study, though the difference was not statistically significant. Berkus et al. [6] have shown that relying on clinical parameters alone without ultrasound confirmation might lead to overdiagnosis of cephalhematoma. Prior studies report a varying incidence of cephalhematoma with a conclusion that its incidence decreases as more experience is gained with ventouse extraction. We did not use ultrasound to confirm cephalhematoma in our study; however, the effect of the operator experience on incidence of cephalhematoma was reflected in our study as well. Of the six cephalhematoma observed in the vacuum extractor group, four occurred in the subset of women who failed to deliver by vacuum extractor and were subsequently delivered by forceps. In all the four women, the least experienced operator had applied the instrument. It is clear that keeping to the recommended indications and complying with the guidelines of the number of pulls and avoiding extensive periods of traction decrease the risk of injury to the fetus.

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