Original Research Article

Comparative study of maternal and fetal outcome with forceps application versus vacuum extraction in caesarean section

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Abstract

Introduction: Instrumental delivery is an art that is fading and may disappear in the near future also increasing safety of section more obstetricians are resorting to caesarean sections leading to increasing trends of section and its complications. Instrumental delivery for floating head during C-section comprise use of vacuum or forceps in selected cases thereby reducing maternal morbidity in terms of blood loss , extension of uterine incision and fetal morbidity by decreasing time taken for incision -delivery interval. **Aims:** To compare the forceps application with vacuum extraction of fetal head during caesarean section for cases with anticipated or actual difficulty in delivery. **Materials and methods:** It is a observational prospective study comparing the maternal and fetal outcome with intracaesarean forceps application and vacuum extraction of fetal head during the time period of one year. 100 cases of anticipated or actual difficulty in head delivery during caesarean section, 50 cases of forceps application were compared with vacuum application of 50 cases aided for fetal head delivery, with regard to maternal and fetal outcome, on basis of simple randomisation technique.**Results:** U-D Interval difference between the two groups(vacuum and forceps) is not statistically significant. Instrument application to delivery interval is shorter in forceps group. More number of cases involving uterine angle and requiring fundal pressure. The amount of blood loss during caesarean section is significantly higher in forceps group in comparison with vacuum group. The difference in birth weight between two groups is not statistically significant .Apgar score of neonates at one and five minutes of both the groups were similar. 3 cases had Apgar score between 4-7 in forceps group, which is attributable to associated comorbidities, i,e., placenta previa in one case and antepartum eclampsia in other 2 cases. In vacuum group also 3 neonates had apgar scores between 4-7, probably due to comorbidities i.e.,Gestational Hypertension in 3 cases. No obvious injuries were seen in neonates of each groups.**Conclusion:** The use of vacuum device is a safe and effective technique to assist delivery during caesarean section. With the rising rate of caesarean section, there is a need for surgeons to expertise in vacuum delivery technique to provide safe and effective delivery of floating head to prevent complication due to dislodgment of head from uterine incision site.

Keywords: Vacuum Delivery, Forceps, Fundal Pressure

Introduction

Caesarean section is one of the most common surgeries performed on women worldwide. Caesarean section is the delivery of the viable fetus, placenta and membranes through an incision in the abdominal wall and the uterine wall. When introduced it had come as a boon to save lives of many women and neonates who otherwise would have suffered severe morbidity and mortality due to intrapartum complications like prolonged and obstructed labour, cephalopelvic disproportion, malposition's and malpresentations, placenta previa. etc. The rate of caesarean delivery has increased dramatically worldwide over the past several decades and now exceeds 55% of all deliveries in many countries[1].In the US, caesarean section frequency has surpassed 30% for nearly a decade [2] , with a wide distribution that ranges from 7.1% to 69.9% across hospitals. Worldwide caesarean section rates have increased from 6.7% in 1990 to 19.1%in 2014[3].Despite public health efforts to optimise and curtail caesarean section utilization, delivery rates by this method continue to rise unabated.Over the last three decades, there is steady rise in caesarean sections globally. This has mainly happened due to expanding indications for primary caesarean section. We now perform elective caesarean section in almost all breech pregnancies, preterm labour, IVF(in vitro fertilization) pregnancies, advanced age pregnancies and morbid obese mothers. Availability of advanced facilities of intrapartum fetal monitoring aided in detection of intrapartum fetal distress early, leading to increase in caesarean section rate. These higher rates of primary caesarean sections have led to very high repeat caesarean section rates. These factors like previous caesarean section, morbidly obese women and preterm elective caesarean section have brought in their wake peculiar situation for the delivery of baby during caesarean section. Because of more elective caesarean section surgeons encounter more cases not in labour and head mobile. Delivering mobile head is difficult especially if it is associated with polyhydramnios. A major technical problem of delivery by caesarean section is delivery of fetal head through the uterine incision. Difficulty in fetal extraction occurs in 1-2% of caesarean deliveries. In an elective caesarean section, the lower uterine segment is commonly not elongated or effaced by labour, making it difficult to create an adequate incision to enable an uncomplicated delivery. High floating or mobile fetal head may displaced and leads to many complications while delivering the baby. Procedure to facilitate delivery in this situation include fundal pressure, internal podalic

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version or addition of a lateral vertical incision or letting the liquor to drain out before delivery of fetal head all of which can be traumatic to both mother and fetus. Either forceps or a vacuum device is often used to assist in delivery of the fetal head in caesarean section when the delivery is difficult and where atraumatic manual delivery of fetal head is not possible.Floating fetal head this need for the physicians to expertise in the techniques of fetal delivery and usage of instruments to deliver fetal head to shorten the uterine incision to delivery time interval in caesarean section. The use of vacuum or forceps to assist in delivery of the fetal head at caesarean section has been increasing in recent years and it has been pointing out that the risk of neonatal depression may be decreased by decreasing the incision to delivery time interval which will be achieved by vacuum or forceps use and its use is a well-established part of obstetric practice in recent years. To compare the forceps application with vacuum extraction of fetal head during caesarean section for cases with anticipated or actual difficulty in delivery with respect to time taken for delivery, number of attempts with each instrument, Success rate, Maternal morbidity and Perinatal outcome.

Material and methods

It is an observational prospective study comparing the maternal and fetal outcome with intracaesarean forceps application and vacuum extraction of fetal head during the time period of one year from October 2020 to December 2020. All pregnant women with gestation age >37 weeks undergoing emergency or elective LSCS (lower segment caesarean section) with difficulty in fetal head delivery during caesarean section at inpatient of department of OBG, GMC, Nizamabad. In Approximately 100 cases of anticipated or actual difficulty in head delivery during caesarean section, 50 cases of forceps application were compared with vacuum application of 50 cases aided for fetal head delivery, with regard to maternal and fetal outcome, on basis of simple randomisation technique. On basis of previous studies available, and the statistics of deliveries per month in our hospital, sample size is selected

Sujata Swain et al study indicated U-D interval mean ± SD in F(forceps) group was 70.2±5.02 and in V(Vacuum) group was 62.3±2.03. with the mean and standard deviation of two groups , the minimum required sample size with 80% power and 5% level of significance is 48 patients in each group. On the basis of statistics of deliveries in our hospital and difficulty in fetal head delivery during caesarean section done in one-year duration , 50 patients were enrolled in each group[4].

Sample size formula:

$$n = \frac{2{s_p}^2\left[Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right]^2}{\mu_d^2}$$

$$S_p^2 = \frac{S_1^2 + S_2^2}{2}$$

Standard deviation in group F =5.02
Standard deviation in group v =2.03
Alpha Error(%) = 5
Power(%) = 80
Required sample size per group according to formula n = 48

Inclusion Criteria: Singleton pregnancy, Live fetus, Vertex presentation, >37 weeks of gestation AND Anticipated or actual difficulty in head delivery (floating head, polyhydramnios, oligohydramnios, obese women.)

Exclusion Criteria: Multiple gestation, Intrauterine fetal demise, Malpresentation (other than vertex), Fetal structural malformations and Preterm(< 37 weeks of gestation)

A detailed history of patient was taken at the time of admission regarding age, parity, socioeconomic status. Thorough general physical examination and systemic examination was done. The subjects undergoing caesarean section were assessed regarding possible difficulty in head delivery by clinical examination i.e., presence of features like floating head, polyhydramnios, oligohydramnios and big baby. The patient details i.e., gravida, parity, gestational age was noted. Indications for present caesarean section and associated comorbid factors were noted. Both elective and emergency cases were included. Forceps and vacuum were applied at random in different cases. In cases with difficulty in head delivery during surgery without the above features forceps and vacuum were used at random. Method of randomisation used is simple randomisation method.The woman and their attenders were counselled regarding the procedure of caesarean section and application of forceps and vacuum during surgery and informed consent were taken.Thus, the safety (of mother and fetus) and efficacy of vacuum extraction was compared with that of forceps application during caesarean section, in regard of maternal and fetal outcome.

Statistical Analysis: This is an observational study involving term (>37 weeks GA) pregnant women taken for emergency or elective LSCS (lower segment caesarean section) undergoing forceps or vacuum assisted fetal head extraction at caesarean section. Continuous variables are represented as mean and standard deviation where Data follows normal distribution, otherwise as median with range. Categorical variables are represented as frequencies and percentages. The statistical significance in the difference in the outcome variables between the groups and was assessed t-test, Fisher exact test or chi-square test. P values (<0.05) are considered to be significant. Data was analysed using R studio.

Results

Table 1: Details of patients in study

Maternal Age(Years)	Vacuum	Forceps	P-Value
Mean	26.92±3.62	26.86±3.64	0.6
Weight in kgs.			
Mean	25.36±3.08	25.14±3.35	0.7
Time Interval(Sec)			
U - D interval (Mean)	64.86±12.31	60.80±14.08	0.12

Both the groups (vacuum and forceps) were comparable in regard of maternal age as weight as the p value is not significant. U-D Interval difference between the two groups(vacuum and forceps) is not statistically significant. Thus, both are equally effective in aiding fetal delivery in caesarean section.

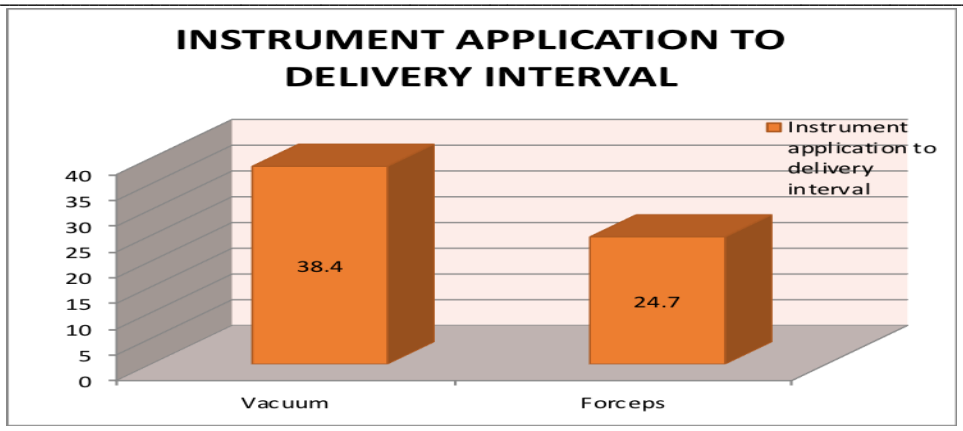

Fig 1: Time interval from instrument application to delivery (seconds)

P value < 0.01 Significant

Instrument application to delivery interval is shorter in forceps group, this may be due to time required for vacuum cup placement and build-up of traction.

Table 2:Comparison of both groups in study related variables

Number of previous surgeries	**Vacuum**	**Forceps**	**P-Value**
Primary LSCS	24	21	0.8
Second LSCS	20	22	
Third LSCS	6	7	
Elective and emergency cases			
Elective	28	22	0.99
Emergency	22	28	
Number of attempts for successful delivery			
Single attempt	47	44	0.29
Two attempts	3	6	
Number of cases of failed instrumentation			
Success	48	46	0.67
Failed	2	4	

Both groups are similar in Number of previous surgeries, number of elective and emergency cases, number of attempts of successful delivery and failed instrumentation.

Table 3: Number of cases of angle involvement , fundal pressure and blood loss with each instrument

Uterine angle	**Vacuum**	**Forceps**	**P-Value**
Involved	2	14	0.03.Significant
Not Involved	48	36	
Fundal Pressure			
Required	0	27	**<0.01. significant**
Not Required	50	23	
Blood loss (ml)	422.2±73.32	**496.2±116.5**	**<0.01. significant**

More number of cases involving uterine angle and requiring fundal pressure. In forceps group number of cases of placenta previa were more compared to vacuum group. The amount of blood loss during caesarean section is significantly higher in forceps group in comparison with vacuum group.

Table 4: Fetal parameters of both the groups

	Vacuum	**Forceps**
Birth Weight(Kg)Mean ±Sd	2.94±0.43	2.92±0.32
APGAR score at one minute(4-7)(No. of cases)	3	3
APGAR score at one minute(>7)(No. of cases)	47	47
APGAR score at 5 minutes(4-7) (No. of cases)	0	0
APGAR Score at 5 minutes(>7) (No. of cases)	50	50
Fetal Injuries	Nil	Nil

The difference in birth weight between two groups is not statistically significant. P value=0.83.

Apgar score of neonates at one and five minutes of both the groups were similar. 3 cases had Apgar score between 4-7 in forceps group, which is attributable to associated comorbidities, i,e., placenta previa in one case and antepartum eclampsia in other 2 cases. In vacuum group also 3 neonates had Apgar scores between 4-7, probably due to comorbidities i.e., Gestational Hypertension in 3 cases.No obvious injuries were seen in neonates of each groups.

Discussion

During caesarean section, difficulty in head delivery is encountered in about 1-2% of cases. In such circumstances usually, forceps are used. Usage of intracesarean vacuum is not done routinely and is a part of clinical studies. Forceps and vacuum were originally designed for use during difficult vaginal deliveries. There are many studies that have compared these two instruments for maternal and neonatal outcome when used vaginally. Such studies give an insight into the general advantages and disadvantages with each instrument. Though the idea of intracesarean use of these instruments is not new, there are not many studies on this subject. The studies that are available are done either without controls or have compared the technique of normal caesarean section with any one of these instruments. There are very few studies comparing vacuum and forceps with each other for intracesarean use.This prospective study included 50 cases of caesarean section, with vacuum assisted delivery using the soft cup vacuum extractor on fetal scalp (diameter: 6 cm) and 50 cases of caesarean sections with forceps application on fetal head, matched for variables like age, parity, gestational age and BMI. Elective and emergency cases were included of Gestational age (37-42 weeks) and vacuum and forceps applied randomly.For those delivered by means of vacuum assistance, after uterine incision vacuum cup was placed at flexion point (3 cm anterior to the posterior fontanelle). It was not possible to always place the cup at flexion point. The vacuum cup was placed to evenly cover and adapt to the entire occiput and the individual fetal head contour.

Vacuum pressure was not exceeded 300mm Hg, unlike in vaginal deliveries where 500 to 600 mmHg of suction pressure is needed. Unlike in vaginal delivery vacuum application, where chignon formation takes about 3 to 10 minutes after suction is applied, there is no need to wait for chignon formation for intracesarean vacuum. Here the suction builds up with in 10 to 40 seconds. Also, the "pop-offs" are very few for intracesarean vacuum. This could be explained by the fact that the maternal pelvic tissues offer high resistance to traction during vaginal vacuum extraction unlike during caesarean section where much less resistance is encountered. Two sudden disengagements (pop offs) of the vacuum cup mandated abandonment of the procedure, and delivery was carried out by any expedious manner. Following delivery of fetal head, vacuum was discontinued and cup was removed. For those delivered by means of forceps , short curved obstetric outlet forceps were used for fetal head extraction. Once the hysterotomy had been performed , one of the blades was introduced depending on the side (to make locking easier) so that it lied against the cheek in front of the anterior ear. The placement of the blade was facilitated by putting one hand under the head and sliding the blade between the fingers and thus moving the fetal head into position and was fixed. The other blade was then applied directly by lifting the anterior uterine wall with fingers thus sliding the blade into place. The shanks were locked. The correct position of forceps was checked by making sure that the sagittal suture was oriented transversely between the blades. Adjustments were made as needed. The traction was applied, without rotation, along the long axis of the mother. Fundal pressure was used to assist extraction.All deliveries were timed, using stopwatches, from the time of entry into the uterus until the full delivery of the fetal head. Presence of any complication like extension of uterine incision, involvement of uterine angle, postpartum haemorrhage was noted. Blood loss for the procedure was estimated. The general condition of the infant was assessed.Neonatal Apgar scores (at 1 and 5 min), evidence of any neonatal trauma (including scalp abrasions, bruising, cephalhematoma, subgleal and intracranial haemorrhage) and need for neonatal resuscitation were observed.The randomization sequence allocated 50 women in the vacuum extraction group and 50 women in the forceps application group. Their demographic factors are noted in table no. 1 & 2.The maternal age in vacuum extraction group was 26.92±3.62 years, in the forceps application group it was 26.86±3.64 years(p value= 0. 93). The BMI in the vacuum extraction group was 25.36± 3.08 Kg/m^2, in the forceps application group was 25.14±3.35 Kg/m^2 ,p value=0.73). We note that the mean age and the mean BMI were similar between two groups, p value not being statistically significant between the groups.

In the study conducted by Sritippayawan S et al, there was no significant difference in mean maternal age group between two groups (manual and extraction group) (p value 0.194) and BMI between two groups(p value= 0.86) as in the present study. This study is also comparable to study conducted by Swain S et al, in which there is no significant difference in demographic factors between forceps and vacuum groups, which shows maternal age P value=0.725 and BMI P value= 0.470. Both elective and emergency cases were included in the study. No. of elective and emergency cases in vacuum and forceps groups were similar (p value=0.99).

In the study done by Arad I et al[6] the U-D interval in the manual extraction group was 40.9± 9.8 seconds and in the vacuum extraction group it was 79.4±10.2 seconds. Sritippayawan S et al[5] found the U-D interval in the manual extraction and forceps extraction group to be 86.3 ±53.9 seconds and 65.3± 31.2 seconds respectively. The U-D interval in the manual and vacuum extraction groups was 43.5±8.6 seconds and 75.6±9.02 seconds respectively, in the study done by Banu F et al[7]. The difference in the U-D interval was found to be significant in the studies done by Arad I et al[6] P< 0.01), Sritippayawan S et al[5] (P< 0.001) and Banu F et al[7] (P<0.0001). The U-D interval in the study conducted by Swain S et al[4] in the manual extraction group was 90.56± 4.91 seconds, in the forceps extraction group was 70.2±5.02 seconds and in the vacuum group it was 62.3±2.03 seconds. No significant difference was observed in the U-D interval between the forceps and vacuum extraction groups(P=0.22).

In the present study, the U-D interval in vacuum extraction group was 64.86±12.31seconds and in forceps application group it was 60.8±14.08 seconds, difference between the two groups is not statistically significant.(P value=0.12).,In the study done by Arad I et al[6], the prolongation of U-D interval may be due to time required for vacuum cup application and build-up of suction.

Table 5: Comparison of U-D interval in various studies

U-D(seconds) interval(mean±SD)	M(manual) group	F(forceps)group	V(vacuum) group
Arad I et al[6]	40.9±9.8	_	79.4±10.2
Sritippayawan S et al[5]	86.3±53.9	_	65.3±31.2
Banu F et al[7]	43.5±8.6	_	75.6±9.02
Swain S et al[4]	90.56±4.91	70.2± 5.02	62.3±2.03
Present Study	_	60.8±14.08	64.86±12.31

Thus, the result of U-D interval means of vacuum group of present study(64.86±12.31)is comparable to that of Sritippayawan S et al study (65.3±31.2) and is also comparable to Swain S et al (62±2.03).The P value of U-D interval between forceps and vacuum group of the present study is not significant as shown in Swain S et al[4] study.In the present study, The I-D Interval in vacuum extraction

group was 38.4±13.34seconds and in the forceps extraction group it was 24.7±13.64 seconds, which is statistically significant (p value<0.01). The I-D interval of vacuum group in present study is similar to Banu F et al[7] study which showed scalp traction time 32± 3 seconds and Dimitrov et al[8] study, in which scalp traction time was 30± 3 seconds. Though I-D Interval in forceps group is short, the U-D interval difference between vacuum and forceps group is not statistically significant (p value=0.12). Crawford J.S et al[9] demonstrated that the time elapsing between the initial incision of the myometrium and complete delivery of fetus was directly related to the fetal distress. Thus, vacuum is as safe as forceps, as it aids in easy and quick delivery of fetus.In the present study, Uterine incision extension and angle involvement was seen in 14 cases of forceps group (28%) and in only 2 cases in vacuum group (4%) (P value= 0.03). Uterine incision extension in vacuum group was similar to Banu F et al[7] study. In the present study, an interesting finding was that in all the cases of intracesarean vacuum with extension of incision and angle involvement, it was always the left angle that was involved. This could be due to the direction of pull that is more towards the operating surgeon standing on the right side of the patient. Also, it is not always possible to place the ventouse cup over the flexion point. This calls for more vigilance from the operating surgeon for traction to be perpendicular to plane of application and maximum possible flexion of the fetal head before application of the ventouse cup.In the present study, the mean estimated blood loss in forceps group was 496.2 ml and in vacuum group it was 422.2 ml, which is statistically significant(p value<0.01). This is comparable to Swain S et al[4] study, which showed statistically significant blood loss difference in mean value between forceps and vacuum group(P value=0) , vacuum extraction group showing less blood loss.In this study, Fundal pressure was applied in 27 cases(54%) in forceps group and in 0 cases in vacuum group. Thus, there was no maternal discomfort in vacuum group as no fundal pressure was applied. In study of Swain S et al[4], none of the cases of vacuum group required application of fundal pressure similar to the present study. Forceps, when applied, occupies space within the uterine cavity unlike the vacuum cup which lies outside the uterine cavity[3]. This could explain the increased requirement of fundal pressure (p <0.01) and a greater number of angle extensions (p=0.03)seen with forceps. This also makes vacuum an ideal instrument for severe oligohydramnios and dense intraoperative adhesions cases where space for intrauterine manipulation is limited. According to Kim TY et al[10], systolic aortic blood flow, cardiac output, heart rate, and arterial blood pressure all decrease significantly during the period when fundal pressure was applied compared with values recorded after uterine incision. Thus, vacuum extraction is safe with less blood loss and decreases maternal discomfort when compared to forceps extraction. Three cases (6%) in vacuum group required 2 attempts for successful delivery of fetal head, whereas in forceps group, 6 cases (12%) required 2 attempts for delivery. However, the difference is not statistically significant (p value=0.29). The vacuum group was superior to forceps group in successful delivery in single attempt. Failed instrumentation, i,e., failure to deliver the baby with the instrument assigned was seen in 2 cases(4%) in vacuum group and in 4 cases(8%) in forceps group in the present study(p value-0.67). However, the difference is not statistically significant. In vacuum group, both the cases delivered manually in an attempt to apply vacuum, before build-up of pressure. In forceps group, one delivered manually in an attempt to apply forceps, two cases delivered by vacuum after two attempts with forceps and one case was delivered with fundal pressure after two attempts with forceps.In the present study, neonatal birth weight (Mean±SD) in vacuum group was 2.94±0.43 and in forceps group it was 2.92±0.32, with P value= 0.83. There was no significant difference in the birth weight between two groups, which is similar to the study of Arad I et al, Sritippayawan S et al, Banu F et al[6] and Swain Set al[4]. Our results did not show differences in the Apgar score on the First and Fifth minute in the new-borns of the two groups, similar to the study of Sritippayawan S et al[5], Banu F et al. In the present study, Apgar score at first minute of 3 neonates was between 4-7 in each of forceps and vacuum group, which may be attributed to associated comorbidities i,e., one case of placenta previa and two cases of antepartum eclampsia in forceps group and three cases of gestational hypertension in vacuum group. Apgar score of neonates at fifth minute was > 7 in all cases of both the groups. Similar to the study of Sritippayawan S et al, and Swain S et al there was no scalp and other neonatal injuries in both the groups, showing safety of both the instruments for neonate during caesarean delivery.

Conclusion

When the vacuum device is used appropriately, the delivery can be facilitated by decreasing the volume delivered through the uterine incision due to the avoidance of a delivering hand or forceps blade so that it prevents the extension of uterine incision**.** The vacuum may lead to decreased uterine incision extensions and decrease in blood loss associated with efforts to deliver the head in difficult cases **.** Without need for excessive fundal pressure, maternal discomfort can be minimised. The use of vacuum device is a safe and effective technique to assist delivery during caesarean section. With the rising rate of caesarean section, there is a need for surgeons to expertise in vacuum delivery technique to provide safe, rapid and effective delivery of fetus with floating head especially in caesarean section.

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