RESEARCH ARTICLE

Forceps (Ergonomic Operation): An Effective Aid for Fetal Head Delivery during Cesarean Section

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Abstract

Aims and objectives: To focus on comparison of forceps-assisted vs manual method of fetal head extraction during lower segment cesarean section (LSCS). Comparative study to identify the safety, effectiveness, and ease of obstetric forceps for delivery of head in cesarean section.

Methods and materials: After getting ethics approval, the total 66 mothers from the ANC, attending antenatal OPD, and Emergency admitted for cesarean section in different indications fulfilling the selection and exclusion criteria. These were selected, randomized, and allowed into two groups such as group A ($n = 33$) = cases (forceps) and group B ($n = 33$) = controls (manual) in each group consisting of 33 patients. The data collection, data analysis, and the outcomes of individual groups analyzed as primary outcomes, secondary outcomes, newborn outcomes were tabulated and statistically significant calculated by GRAPH-PAD software.

Results and analysis: In our study, the primary outcomes were statistically significant as weight, BMI, estimated intraoperative loss, drain volume in 48 hours, the weight of mops, PCV-drop, and the hemoglobin drop complicated with chest discomfort, required transfusion as blood, FFP, platelets, volume expanders needed intensive and/or critical care. The outcomes were significant in operation time with U-D time, difficulties head delivery and assisted fundal pressure, required conversion and ultimately failure to deliver. Intraoperative events were significant as extension/laceration-associated angle hematoma, stitch line hematoma, window at stitch site, cut through and apposition failure with major hazards landed in major operations. The indicators of the secondary outcomes in postoperative and follow-up period were revealed statistically significant as mobilization time, oral feeding time, pain and discomfort, analgesics requirement, developed febrile illness, and wound complications necessitated hospital stay with recovery-satisfaction and costs. The newborn outcomes were observed significant in form of I-D time, meconeum stain, weight, preterm, IUGR, cried at birth with Apgar score, needed essential newborn care (ENC), and NICU admission.

Conclusion: Considering the outcomes, with proper selection of patient(s), application of forceps produced statistically significant better outcomes during cesarean operation than manual extraction. Recommended routine forceps application in cesarean delivery.

Keywords: Decreased maternal and perinatal morbidities and mortalities, Lower segment cesarean section, Minimizes complications, Routine forceps application, Safe delivery.

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Background

The key to avoid problem and obstetrician's palpitations is anticipation and planning. Keeping all the factors in mind, one must know when to expect trouble, plan accordingly anesthesia, abdominal entry, uterine incision, and method of baby delivery. The obstetricians should know a details knowledge of fetal lie, presentation, station, degree of flexion, position of occiput and placental localization helps to plan the method of delivery by which to reduce adverse neonatal outcome, induction delivery interval of more than 8 minutes and incision delivery interval of more than 3 minutes.[1–3]

Introduction

Non vi sed arte… (Not by force but by skill…)

—Hippocrates

This should be followed to have ''Healthy Mother and Healthy Baby.'' Today public perception of C-section has swung from ''failure of obstetrics care'' to ''safe for mother and child,'' so the primary goal of an obstetrician is to do no harm, following the cesarean section which is a commonly performed procedure in obstetrics practice and the globally, there is a rising rate.[4] Over the last three decades, there is a steady rise in cesarean sections globally, those are mainly due to expanding indications for primary cesarean section, "previous cesarean section" that contributing to almost 40–50% of CS (US – 21–32%).[5,6] Difficult fetal extraction occurs in approximately one in ten cases (difficult fetal extraction occurs in 1–2%) with a major technical problem during delivery of the fetal head through the uterine incision cesarean deliveries more commonly seen with preterm, elective, late intrapartum (advanced labor), a mal-positioned baby, fetus with high floating head or deeply engaged head and placenta previa that problem solved by application of either forceps or a vacuum device where atraumatic

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manual delivery of fetal head is not possible.[7–10] The purpose of this study is to compare the safety (for mother and fetus) and efficacy of forceps-assisted delivery of high floating/mobile fetal head with the traditional method of manual extraction at cesarean section. We have also outlined current concepts and have enlisted suggestions to ease the delivery of the baby with the evidence base. The current conventional practice is to insert fingers through the uterine wound between the head and the lower segment till fingers reach below the head, and then the head is levered out, and the difficulties encountered managed by-ERR: Outlined by Chao, ERR sequence (Elevate – Rotate - Reduce).[11] The long trial (deeply engaged head/deep transverse arrest) baby delivery by push the head up from the vagina in Whitmore position till the vaginal hand pushes, pull from above - Back anterior, Back posterior, Back lateral as per Patwardhan maneuvers for different situations, and however, pull vs push-fetal injury rate is same in both techniques according to Barbieri.[12–14] Several studies have confirmed in general that it has been found that a push from the vagina is more traumatic to the baby as well as to the genital tract and pull from above is safer for both the newborn and the mother.[8,15–18] In this study, we attempted specially forceps-assisted cephalic extraction to deliver the presenting part at cesarean section to minimize irregular tearing of the hysterotomy wound, to reduce and minimizes blood loss and to facilitate easy closure. Application of forceps for delivering the head at LSCS is safe, helps for quick delivery of the baby with healthy babies for minimizing perinatal mortalities and morbidities.

Methods and Materials

After getting ethics approval, the total 66 mothers from the ANC, attending antenatal OPD and Emergency admitted for cesarean section in different indications fulfilling the inclusion and exclusion divided into two groups such as group A ($N = 33$) = cases and group B ($N = 33$) = controls. Each of 66 patients:

Group A: Patients with undergoing forceps-assisted delivery of fetal head in lower segment cesarean section (LSCS).

Group B: Patients with undergoing manual extraction of fetal head during LSCS.

Case Selection

Setting

Academic, Research.

Place of Study

Department of Gynecology and Obstetrics, IPGMER - SSKM Hospital, West Bengal, India.

Duration and type of study: 1 (one) year (February 19, 2015–February 18, 2016).

Sampling method: Prospective randomized control study, clinical trial, comparative study.

Sample size calculation: A total of 66 patients. Group A, $n = 33$ (cases) and Group B, $n = 33$ (controls).

Consolidated standards of reporting trails (consort) statement.

Case Selection

Eligibility Criteria

Inclusion Criteria

- Indication of LSCS: (Total 66).
- Post cesarean pregnancy (20).
- Dystocia (10).
- Elective (16).
- Fetal distress (abnormal CTG) (4).
- Prolonged pregnancy with failed induction (16).

Exclusion Criteria

- Mothers advanced age and bad obstetric history.
- Associated medical and surgical comorbidities.
- Coagulation and bleeding disorders, anticoagulant therapy, Hb <10.5%.
- Chronic diseases, smokers, and addicted mothers.
- Developmental malformed uterus, malformed fetus.
- Infective association and immunocompromised.
- Connective tissue and immunological disorders in pregnancy.
- Ante partum hemorrhage of unknown etiology, premature rupture of membrane.

Data collection procedure: Allocation done as sequentially numbered that number was generated computerized number generator into group A (cases = 33), group B (controls = 33). Must registry entry of patients' profile.

Data analysis: The outcomes of individual groups analyzed as primary outcome (organ damage/failure, blood loss, and transfusion), secondary outcome (operation time, mobilization time, oral intake time, analgesic, pain relieved, and satisfaction), (wound complications, hospital stay, costs, and readmission), the general condition of the infant was assessed by the attending pediatrician with representation of fetal outcomes in terms of birth weight, neonatal APGAR scores (at 1 and 5 minutes), evidence of any neonatal trauma (including scalp abrasions, bruising, cephalohematoma, and subgaleal) tabulated and statistical significant calculated by GRAPH-PAD Software in Tables 1 to 4.

Surgical Procedure

The Vectis, Merles head extractor, and Simpson's forceps can be passed with simultaneous fundal pressure will lead to delivery of the head.[19] The application of head disengaging devices like UK-Fetal Disimpacting System, the flat pad, and with proper training of resident doctors and the floating head (an elective pre- labor CS, too large head, preterm fetus, hydramnios, and placenta previa) (head is difficult to grasp and pull with a gloved hand) can be managed by induce uterine contractions, rupture the membranes and instrumental delivery by vacuum, forceps or vectis (single blade).[20–23] Both forceps and vacuum have been tried for delivery of a floating head but better results achieved by forceps (Simpson's – the best suited instrument for head transverse positions/Barton's ergonomic option for cesarean deliveries.[24] As per previous studies, forceps—nuances of forceps application—lower blade of forceps is applied first followed by anterior blade with concavity of pelvic curve toward fetal occiput and then controlled extraction is carried out and vacuum (Kiwi Omni C cup) while applying the vacuum cup to the scalp of the fetus, a tedious interphase of liquor may test the patience of the operator.[25,26] The RCOG-concluded learning and adopting skills for difficult C-section are important to reduce the maternal and fetal complications specially deeply engaged head or a CS during stage II of labor where resident doctors not confident enough and consultant's presence is part and parcel. It also goes on to say "proper training of resident doctors should be done for delivery of deeply engaged head," "underlining the

Table 1: Primary outcomes

Indicators	*Group A (cases = 33)*	*Group B (controls = 33)*	*p-values (FET/UTT)*
Ages (years)	*27.94, *4.51, *0.78	*25.03, *3.93, *0.68	$p = 0.0069$
Weight (kg)	*65.82, *2.11, *0.37	*63.24, *2.22, *0.25	$p < 0.0001$
BMI	*26.55, *1.15, *0.20	*28.91, *1.44, *0.25	$p < 0.0001$
POG (weeks)	*38, *4, *0.70	*39, *4, *0.70	$p = 0.3137$
Organ injury/Damage			
Uterine	01/32	05/28	$p = 0.1968$
Cervical	01/32 (Stained urine)	10/23 (Stained urine)	$p = 0.0060$
Ureteric	01/32	12/21	$p = 0.0012$
Bladder	01/32	09/24	$p = 0.0129$
GIT	02/31	09/24	$p = 0.0440$
Vessels	00/33	08/25	$p = 0.0048$
Excessive hemorrhage	00/33	08/25	$p = 0.0048$
Blood loss	*428, *70, *12.19	*579, *97, *16.89	$p < 0.0001$
Intraoperative loss	*20, *05, *0.87	*50, *08, *1.39	$p < 0.0001$
Drain (within 48 hours)	*150, *50, *8.70	*300, *50, *8.70	$p < 0.0001$
Hb%-drop	*1.0, *0.05, *0.087	*2.0, *0.05, *0.087	$p < 0.0001$
Mops weight (wet–dry)	*400, *50, *8.70	*800, *50, *8.70	$p < 0.0001$
PCV-drop	*1.8, *0.01, *0.0017	*2.7, *0.05, *0.0087	$p < 0.0001$
Transfusion needed			
Blood	03/30 (01 unit)	12/21 (03 units)	$p = 0.0169$
FFP	02/31	18/15 (>01 unit)	$p = 0.0001$
Platelets	04/29	17/16 (>01 unit)	$p = 0.0012$
Volume expanders	10/23	20/13	$p = 0.0253$
Chest discomfort	02/31	28/05	$p < 0.0001$
Blood pressure (hypo)	09/24	20/13	$p = 0.0125$
ITU/CCU care needed	02/31	09/24	$p = 0.0440$
Death	Nil	01	NA

*Mean, *SD, *SEM. FET, Fisher exact test; UTT, unpaired *t*-test

Table 2: Secondary outcomes – Intraoperative events

Indicators	*Group A (cases = 33)*	*Group B (controls = 33)*	*p-value (UTT/FET)*
Operation time	*32, *2.0, *0.35	*48, *3.0, *0.52	$p < 0.0001$
U-D time	*43, *8.0, *1.39	*76, *9.0, *1.57	$p < 0.0001$
Difficulties encountered	04	26	$p < 0.0001$
Fundal pressure	21	33	$p < 0.0001$
Failure to deliver	00	16	$p < 0.0001$
Switched/Conversion	00	12	$p < 0.0001$
Extension	02	14	$p = 0.0004$
Angle hematoma	12	32	$p = 0.0010$
Stitch line hematoma	10	36	$p < 0.0001$
Apposition failure	11	34	$p = 0.0002$
Window at stitch site	14	30	$p = 0.0099$
Cut through and avulsion	07	24	$p = 0.0007$
Damage to uterine, cervical, ureter, bladder, GIT, vessels	05	31	$p = 0.0001$
Major operation needed (hysterectomy/pelvic devascularization)	00	13	$p < 0.0001$

*Mean, *SD, *SEM. FET, Fisher exact test; UTT, Unpaired *t*-test

need for special emphasis on this skill development in residency training program."[22] The selecting patients were matched with demographic variables such as maternal age, weight, parity, and period of gestation (POG) were comparable in both the groups. After taking informed consent and reassuring patients regarding expertise and confidentiality was done.

Manual Extraction of Fetal Head

The physicians were instructed to incise the lower uterine segment and fetal membranes in the typical manner using the scalpel blade and by digital expansion. For those deliveries by means of traditional manual extraction, the physician's hand was introduced into uterus. Fundal pressure was given and lifting the anterior

Table 3: Secondary outcomes (postoperative periods and afterwards)

Indicators	*Group A (cases = 33)*	*Group B (controls = 33)*	*p-values*
Mobilization time	*12, *2, *0.35	*18, *2, 0.35	$p < 0.0001$
Oral feeding time	*12, *2, *0.35	*18, *2, *0.35	$p < 0.0001$
Pain and discomfort	*14,*2,*0.35	*38, *3, *0.52	$p < 0.0001$
Analgesics required	*18, *2, *0.35	*36, *2, *0.35	$p < 0.0001$
Febrile illness	05	20	$p = 0.0003$
Wound complications	06	23	$p = 0.0001$
Hospital stay	*7, *2, *0.35	*10, *2, *0.35	$p < 0.0001$
Recovery-satisfaction	33/00	12/21	$p < 0.0001$
Readmission	01	05	NA
Costs (sutures others)	<3/case-less drugs	>5/case-more drugs	NA

*Mean, *SD, *SEM. FET, Fisher exact test

Table 4: Newborn outcomes

Indicators	*Group A (cases = 33)*	*Group B (controls = 33)*	*p-value*
I-D time	10, 02, 0.35	15.05, 0.87	0.0001
Cried at birth	27/06	11/22	0.0001
Preterm	12/21	26/07	0.0010
IUGR	08/25	21/12	0.0026
Meconium stain	07/26	19/14	0.0051
Birth injury	02/31	23/10	0.0001
ENC	04/29	18/15	0.0005
Baby weight	2.12 ± 0.545 kg	2.6 ± 0.544 kg	
<1.5 kg	08/25	19/14	0.0116
1.5–2.0 kg	09/24	20/13	0.0125
2.0–2.5 kg	13/20	22/11	0.0477
>2.5 kg	10/23	25/08	0.0005
Apgar score:			
7–10	24/09	11/22	0.0028
4–6	07/26	21/12	0.0010
NICU-admission	05/28	15/18	0.0148
Death	00/33	02/31	0.1643

Birth injury (scalp abrasions, bruising, cephalohematoma, subgaleal age).*Mean, *SD, *SEM. FET, Fisher exact test; I-D time, Incision to delivery time

uterine wall with fingers facilitated fetal head delivery. If delivery was not imminent after one attempt at manual delivery, then it was proceeded with delivery by using forceps blades.

Forceps-assisted Delivery of Floating Fetal Head

Once the hysterotomy had been performed, one of the blades, short-curved obstetric outlet forceps were introduced depending on the side (to make locking easier) so that it lied against the cheek in front of the anterior ear, 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 with shanks were locked. The correct position of the forceps was checked by making sure that the sagittal suture was oriented transversely between the blades with adjustments as needed. Then traction was applied, without rotation, along the long axis of the mother. Fundal pressure was used to assist extraction as per requirement. While guiding the head out of incision, the vertex was flexed by digital pressure on the bones converging at the posterior fontanelle.

Results and Analysis

The data collection and the data analysis in forms of the outcomes of individual groups analyzed as primary outcomes, secondary outcomes, and the neonatal outcomes were tabulated and statistically significant calculated by GRAPH-PAD software in Tables 1 to 4.

Discussion

The available study reports revealed the followings: Sritippayawan and Chantrapitak observed that there was no significant difference in the mean maternal age-groups ($p = 0.581$), no significant difference of maternal weight, BMI, ($p = 0.864$), and also there was no significant difference in the estimated blood loss between the manual and forceps extraction groups ($p = 0.99$).[9] Arad et al. and Banu et al. showed that there was no significant difference in gestational age ($p = 0.42$).[27,28] Ambwani et al., Iqbal and Sumaira, and Khurshid and Sadiq showed no etiology of non-engagement cases (43%).[29–31] The difference in U-D interval was found to be significant in the studies done by Arad et al. ($p < 0.01$), Sritippayawan and Chantrapitak ($p < 0.001$), and Banu et al. ($p \leq 0.0001$); and Sritippayawan and Chantrapitak and Poordast et al. found that there was no scalp injury in two groups.[9,27,28,32] Banu et al. and McQuivey et al. found that extension of uterine incision in manual extraction group was similar to that of the study done.[28]

In our study, the primary outcomes as patients' ages (years) ($p = 0.0069$), weight (kgs) ($p < 0.0001$), BMI ($p < 0.0001$), and POG (weeks) ($p = 0.3137$). During the procedure, the complications (the organs involvement) were occurred like uterine ($p = 0.1968$), cervical ($p = 0.0060$), ureteric ($p = 0.0012$), bladder ($p = 0.129$), GIT ($p = 0.0440$), vessels ($p = 0.0048$) leading to excessive hemorrhage ($p = 0.0048$) that was estimated blood loss ($p < 0.0001$), intraoperative loss ($p < 0.0001$), drain volume in 48 hours ($p < 0.0001$), the weight of mops ($p < 0.0001$), PCV-drop ($p < 0.0001$), and the hemoglobin drop ($p < 0.0001$) were complicated with chest discomfort ($p < 0.0001$), and hypotension ($p = 0.0125$), required transfusion as blood ($p = 0.0169$), FFP ($p = 0.0001$), platelets ($p = 0.0012$), volume expanders ($p = 0.0253$) needed intensive and/or critical care ($p = 0.0440$) and death (00 and 01) (p = NA). The statistical records of observed intraoperative events of secondary outcomes were operation time ($p < 0.0001$) with U-D time ($p < 0.0001$) encountered difficulties ($p < 0.0001$) assisted fundal pressure ($p < 0.0001$), required switched/conversion ($p < 0.0001$) and ultimately failure to deliver ($p < 0.0001$). Intraoperative events were extension/laceration ($p = 0.0004$) associated angle hematoma ($p = 0.0010$), and during reconstruction, there were stitch line hematoma ($p < 0.0001$), window at stitch site ($p = 0.0099$), cut through and avulsion ($p = 0.0007$) resulting in apposition failure ($p = 0.0002$). The major hazards were damage to uterine, cervical, ureter, bladder, GIT, vessels ($p = 0.0001$) landed in major operations (hysterectomy/pelvic devascularization) ($p < 0.0001$). The indicators of the secondary outcomes in postoperative and follow-up period were revealed statistically significant as mobilization time ($p < 0.0001$), oral feeding time ($p < 0.0001$), pain and discomfort ($p < 0.0001$), analgesics requirement ($p < 0.0001$) developed febrile illness ($p = 0.0003$) and wound complications ($p = 0.0001$) necessitated hospital stay ($p < 0.0001$) with

recovery satisfaction ($p < 0.0001$) and costs (suture, drugs and others) (<3/case – less drugs and >5/case – more drugs) (p = NA) but needed readmission (01 and 05) (p = NA). The newborn outcomes were observed inform of I-D time ($p = 0.0001$), revealed meconium stain ($p = 0.0051$), weight <1.5 kgs ($p = 0.0116$), 1.5–2.0 kgs ($p = 0.0125$), 2.0–2.5 kgs ($p = 0.0477$), >2.5 kgs ($p = 0.0005$), detected preterm ($p = 0.0010$), IUGR ($p = 0.0026$) cried at birth (p = 11/22) with Apgar score 7–10 ($p = 0.0028$), 4–6 ($p = 0.0010$), needed essential newborn care (ENC) ($p = 0.0005$), NICU-admission ($p = 0.0148$), and death (00/33 & 02/31) ($p = 0.1643$).

Conclusion

This study reveals that with use of application of forceps in CS for delivery of head, is superior than manual delivery in relation to time, blood loss, and fundal pressure without any adverse effect on neonates and maternal complication. With appropriate training, these can be valuable tools in the armamentarium of the practicing obstetric care providers to effect safe and effective method of delivery of high floating head at CS.

Drawback

As this is a small study, the utility of this instrument has to be further evaluated by randomized controlled or comparative studies with larger sample size. Multicenter study required for its routine application.

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Authors Contribution

All authors contributed.

Ethics Approval

This study is duly approved by Institutional Ethics Committee.

Research Involving Human Participants and/or Animal – Ethical Approval

All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

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Consolidated Standards of Reporting Trials (Consort) Statement

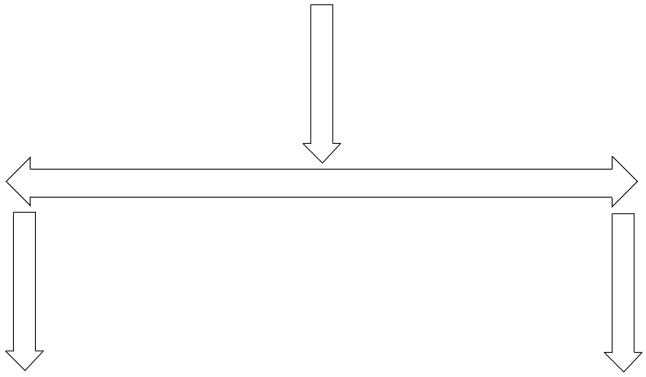
Allocation done Sequentially Numbered Opaque Sealed Enveloped (SNOSE), where sequence generated computerized random number generator.
Envelops number in advanced, opened sequentially only after participants' name and other details written on appropriate envelops.
Envelops contain carbon papers which essential for audit trial.
Must registry entry of patients' profile.

Enrollment

Assessed for eligibility (*N* = 66)
Excluded (*N* = 0)
Not meeting inclusion criteria (*N* = 0)
Declined to participate (*N* = 0)
Others reasons (*N* = 0)

Allocation

Randomized (*N* = 66)



Allocated to intervention [Group A (*N* = 33)]	Allocated to intervention [Group B (*N* = 33)]
Received allocated intervention (*N* = 33)	Received allocated intervention (*N* = 33)
Did not receive allocated (*N* = 0)	Did not receive allocated (*N* = 0)
Follow-up (33):	Follow-up (33):
Lost to follow-up (Reason, *N* = 0)	Lost to follow-up (Reason, *N* = 0)
Discontinue intervention (Reason, *N* = 0)	Discontinue intervention (Reason, *N* = 0)
Analysis	Analysis
Analyzed (*N* = 33)	Analyzed (*N* = 33)
Excluded from analysis (Reason, *N* = 0)	Excluded from analysis (Reason, *N* = 0)