MEDICUS

ISSN 1409-6366 UDC 61 Vol · 30 (1) · 2025

Original scientific paper

Profesional paper

Review

Case report

Profesional paper

RISK FACTORS AND MATERNAL AND NEONATAL COMPLICATIONS ASSOCIATED WITH VACUUM EXTRACTION DELIVERY

Ilir Shurlani[1], Anita Morarcalieva Chochkova[2], Ana Kocevska[1], Iskra Martinovska[1], Sashko Olumcev[3]

[1]Specialized hospital for Gynecology and Obstetrics "Mother Teresa" – Chair, Skopje, Republic of North Macedonia

[2]PHI General Hospital - Gevgelija, Republic of North Macedonia

[3]Public Health Center - Veles, Republic of North Macedonia

Corresponding autor: Ilir Shurlani, MD, Specialized hospital for Gynecology and Obstetrics "Mother Teresa" – Chair, Skopje
Adress: Kosta Abrasevic 3, Skopje
Telephone number: 070372929
e-mail: ilirdok@yahoo.com

Medicus 2025, Vol. 30 (1): 75-80

ABSTRACT

Objective. To establish a correlation between maternal age, maternal BMI, conjugata externa, maternal abdominal circumference, parity, fetal weight and fetal head circumference and vacuum assisted delivery, as well as to analyze maternal and neonatal complications caused by the procedure.

Methods. In our hospital is preformed outlet vacuum assisted delivery exclusively, according to RCOG guideline for Assisted vaginal birth. Indication for vacuum assisted delivery was fetal distress in a term pregnancy. Soft caps were used and performance of mediolateral episiotomy was mandatory. The procedure was preformed by trained operators.

Conclusion. Our study showed that primiparous women with overweight and obesity and those with abdominal circumference of 100 cm and above, are more prone to vacuum extraction. The most common maternal complication is vaginal laceration, and such deliveries require treatment of the mothers and newborns, requiring hospitalization three days or more. Neonatal complications are most often associated with cephalhematoma and livid asphyxia of the newborn.

Key words: vacuum assisted delivery, maternal complications, neonatal complications, risk factors

INTRODUCTION

Most births occur naturally, without the physical assistance of a health care provider. Unassisted birth in the cephalic position accounts for nearly 95% of all births (1). The mother's expulsive efforts, combined with the contractile force of the uterus, provide a coordinated force to push the baby out of the uterus and through the birth canal. Complications may arise and interfere with normal vaginal delivery or require acceleration of labor by common factors, including narrowing of the birth canal, fetal distress, intrapartum infection, maternal exhaustion, pathological conditions, or the size of the baby.

Operative vaginal delivery refers to a delivery in which the operator uses forceps or a vacuum device to assist the mother deliver the fetus to extrauterine life. The instrument is applied to the fetal head and then the operator uses traction to extract the fetus, typically

during a contraction while the mother is pushing.

In the United States, 3.6 percent of all deliveries are accomplished via an operative vaginal approach (3). The overall rate of operative vaginal delivery has been diminishing, but the proportion of operative vaginal deliveries conducted by vacuum assisted births has been increasing and is more than four times the rate of forceps assisted births. Forceps deliveries account for 1 percent of vaginal births and vacuum deliveries account for about 4 percent of vaginal births. In recent years, the success rate for operative vaginal deliveries has been quite high (99 percent) (4).

Vacuum extraction (VE) is the completion of vaginal birth using negative pressure. Together with forceps, it is considered an instrumental (operative) assisted vaginal birth. While completion of birth with forceps is rarely performed today and is no longer used in clinical practice, due to the higher incidence of complications such as peripheral nerve damage, shoulder impingement, skull impression fractures, and birth canal injuries, completion of birth with VE is still present in clinical practice. The first records of the use of a vacuum cup are known since 1632, when Hildanus described the use of the ventouse succion cup, for the purpose of repositioning an impression fracture of the fetal skull. After him, in 1705, James Yonge suggested that this vacuum cup, can be used as an aid in "pulling out" the fetus throught the birth canal. Nevertheless, the first successful vaginal birth completed using "suction traction" was described by James Simpson in 1849. As early as 1875, Stillman modified Simpson's device, and since then instrumental completion of vaginal delivery with the help of a vacuum extractor has been continuously in use (5). In 1953, the Swedish obstetrician, Tage Malmström, introduced a hollow disc-shaped stainless steel metal cup for vacuum assisted delivery. Suction tubing attached to the dome of the cup and a traction chain passed through the tubing. The Malmström cup quickly became the template for all subsequent vacuum extractor systems (6).

On the other hand, efforts were also made in the production of soft and flexible vacuum cups that allow the cup to be adapted to the shape of the fetal head, which would prevent damage to the scalp. The first such cup was designed by Wood in 1963. There have been numerous modifications and redesigns of these cups, but it is also worth mentioning the "M" cup from 1973, which is still used today and Kiwi omnicup. Compared to the rigid metal Malmström cups, the soft materials of these caps bend easily, with minimal risk of trauma. The extraction force is distributed evenly throughout the back of the head and thereby reduces the risk of cephalohematoma (7).

VE assisted delivery can be practiced only if the cervix is fully dilated, if a mediolateral episiotomy has been previously performed, if the fetuses head has descended into the birth canal, and if we know the position of the fetal head. VE must not be done after other failed attempts at instrumental delivery. Therefore, the therms for a successful operative vaginal delivery are a fully dilated cervix, a performed mediolateral episiotomy, prior rupture of the fetal membranes, an engaged fetal head whose position the operator has previously determined, a prior assessment of fetal weight, a pelvis that is considered suitable for vaginal delivery, adequate anesthesia (often epidural), an empty maternal bladder, a signed informed consent and the possibility of a caesarean section in case the delivery does not go as expected (8,9).

Contraindications for performing VE are divided into absolute and relative. Absolute contraindications are proven coagulation disorders (hemophilia or alloimmune thrombocytopenia of newborns, von Willebrand disease..), fetal demineralization diseases (osteogenesis imperfecta), incomplete dilation of the cervix, unruptured membranes, fetal malpresentation, suspicion of cephalopelvic disproportion, gestation less than 34 weeks or estimated fetal weight <2500g and unsigned informed consent. Relative contraindications are suspected fetal macrosomia, inadequate anesthesia and previous attempts at operative completion of vaginal delivery (10).

A maximum of two to three cup detachments, three sets of pulls for the descent phase, three sets of pulls for the outlet extraction phase, and/or a maximum total vacuum application time of 15 to 30 minutes are commonly recommended, with most authors advising lesser time limits [11,12]. Vacuum suction pressures of 500 to 600 mmHg have been recommended during traction, although pressures in excess of 450 mmHg are rarely necessary (green zone). While lower suction pressures increase the risk of cup "pop-offs," pressures beyond 600 mmHg increase the risks of fetal scalp trauma and cerebral, cranial and scalp hemorrhage (13,14).

Failure of the procedure is due to poor patient selection (e.g., attempted vacuum extraction in pregnancies complicated by cephalopelvic disproportion) and errors in

application or technique. Complications are more likely to occur when a metal cup is used rather than a soft cup. Selecting the wrong size or positioning of the vacuum cup and accidentally involving the mother's soft tissues in the cup, can result in worsening asynclitism or fetal head deflection, which can contribute to failed suction attempts. If traction is not applied in conjunction with labor or pushing is performed along the wrong plane, this can also result in failed suction. An increase in fetal scalp edema (caput susscedaneum), lets more of the scalp to be drawn into the cup, which reduces the available vacuum area, and, in turn, lessens total traction. In these cases, the operator should recognize the failure and abandon instrumental completion of vaginal delivery to avoid fetal and maternal injury (15,16).

Short-term maternal risks from instrumental delivery include pain at delivery, perineal pain at 24 hours, lower genital tract lacerations and hematomas, urinary retention and incontinence, anemia, anal incontinence, and rehospitalization (17,18). Long-term maternal sequelae from operative delivery are primarily related to potential disturbances in urinary and anal function, such as urinary incontinence, fecal incontinence, pelvic organ prolapse, and, occasionally, fistula formation (19).

The short-term complications to the fetus from operative vaginal delivery are usually caused by head compression and traction on the fetal intracranial structures, face, and scalp. The most serious complication is intracranial hemorrhage and subdural hematoma that can occure within hours of delivery. Other complications include: bruises, abrasions and lacerations, facial nerve palsy, cephalohematoma, retinal hemorrhage, subgaleal hemorrhage, and skull fracture (20,21,22). Acute fetal injuries with potential long-term sequelae include intracranial hemorrhage (subdural, subarachnoid, intraventricular and/or intraparenchymal hemorrhage) and neuromuscular injury; however, these sequelae are rare (23).

MATERIALS AND METHODS

This study is retrospective by character and includes vacuum-assisted spontaneous deliveries performed at the Special Hospital for Gynecology and Obstetrics Mother Teresa- Chair, Skopje, N. Macedonia, in the period from January 1, 2020 to December 31, 2024. The aim of the study is to establish a correlation between maternal age, maternal BMI, conjugata externa, maternal abdominal circumference, parity, fetal weight and fetal head circumference and vacuum-assisted delivery, as well as to analyze maternal and neonatal complications caused by the procedure. This can improve the assessment of the indication for vacuum-assisted delivery or cesarean section. Inclusion criteria were term pregnancy, previous augmentation with oxytocin, preformed mediolateral episiotomy, signs of fetal hypoxia (cardiotocographic recording and/or meconium amniotic fluid), completely dilated cervix and ruptured membranes, primiparas, multiparas. Exclusion criteria were fetal deflection positions, mothers with previous cesarean delivery, suspected fetopelvic disproportion, failure of an attempted vacuum assisted delivery. An atraumatic soft cup was used for delivery and the procedure was performed by trained operators. In our hospital is preformed outlet VE exclusively, according to RCOG guideline for Assisted vaginal birth (24).

The material was statistically analyzed using the methods of descriptive statistics.

RESULTS

Patients delivered by vacuum extraction were divided into two groups by age, from 18 to 29 years - 35 (72.92%) and over 30 years - 13 (27.08%). 44 (91.65%) were primiparas, and 4 (8.35%) were multiparas.

Body mass index (BMI) was also a parameter analyzed. There were no malnourished patients for analysis. Patients with normal BMI (18.6-24.9) who were delivered by vacuum extraction were 10 (20.83%), overweight (BMI 25-29.9) were 18 (37.50%) and obese (BMI>30) were 20 (41.67%) [table 1].

table 1: BMI and number of patients with vacuum extraction

BMI category	Number of patients	%
Normal (18,6-24,9)	10	20,83%
Overweight (25-29,9)	18	37,50%
Obese (BMI >30)	20	41,67%
Total	48	100%

Conjugata externa was 18cm in 8 patients (16.67%), 19cm in 10 (20.83%), 20cm in 17 (35.42%), 21cm in 10 (20.83%) and 22cm in 3 (6.25%). According to maternal abdominal circumference, they were divided into two groups. Patients with abdominal circumference greater than or equal to 100cm - 31 patients (64.58%) and abdominal circumference less than 100cm (35.42%).

According to the birth weight, the newborns were divided into three groups or newborns under 3000g- 10 (20.83%), from 3000g to 3700g- 30 (62.50%) and over 3700g- 8 (16.67%). The head circumference of the newborns was 33cm in 5 (10.42%) of them, 34cm in 13 (27.08%), 35cm in 14 (29.17%), 36cm in 9 (18.75%) and 37cm in 7 (14.58%).

The number of complications that occurred were 23, of which vaginal lacerations were 14 (60.83%), cervical lacerations were 5 (21.73%) and postpartum hemorrhage occurred in 4 patients (17.39%) [table 2].

table 2: Number of complications

Type of complication	N	%
Vaginal lacerations	14	60,83%
Lacerations of the cervix	5	21,73%
Postpartum hemorrhage	4	17,39%
Total	23	100%

Patients who stayed in the hospital for only 2 days were 6 (12.5%), 3-5 days 23 (47.92%) and over 5 days 19 (39.58%) [table 3].

table 3: Duration of hospitalization

Duration of hospitalization	Number	%
2 days	6	12,5%
3-5 days	23	47,92%
> 5 days	19	39,58%
Total	48	100%

A total of 132 complications occurred in a total of 79 newborns, of which 41 (31.06%) required resuscitation, pale asphyxia occurred in 20 (15.15%), livid asphyxia in 28 (21.21%), cephalhematomas were 26 (19.70%), clavicle fractures 2 (1.52%) and 15 intraventricular hematomas (11.36%) [table 4].

table 4: Complications in newborns

Type of complication	N	%
Need for resuscitation	41	31,06%
Pale asphyxia	20	15,15%
Livid asphyxia	28	21,21%
Cephalhematomas	26	19,70%
Fractures of the clavicle	2	1,52%
Intraventricular hematomas	15	11,36%
Total	132	100%

DISCUSSION

Our study showed that vacuum extraction assisted delivery was more commonly performed in the younger age group, i.e. under 30 years of age. This is a result of the relatively younger population delivering in our hospital. According to Schreiber et al. (2024), older nulliparous women are more likely to undergo vacuum extraction than younger primiparous women (25). This is consistent with our analysis, which showed that parity plays an important role in the need for vacuum assisted delivery. Namely, over 90% of vacuum assisted deliveries are in primiparous women.

According to body weight, it is well known that obese patients are more likely to require vacuum-assisted delivery. The rate of delivery with the application of a vacuum extractor in them, is twice as high as in patients with a normal BMI (26). Our study showed that two-thirds of the patients delivered with the help of vacuum extraction were overweight or obese according to BMI. The maternal abdominal circumference was greater than 100 cm in as many as 65% of them. All this depends not only on the maternal abdominal circumference, but also on the weight and head circumference of the delivery object. However, our study showed that over 60% of vacuum extractions were applied to neonates with normal birth weight and normal fetal head circumference. In contrast, Aberg et al. claim that macrosomic fetuses have a greater need for assisted delivery and the frequency of neonatal complications is directly proportional to the weight of the fetus. Larger fetuses are more likely to require assisted and cesarean delivery (27, 28).

The complication rate after vacuum extraction is higher than the complication rate after spontaneous birth. Over 60% of patients had vaginal laceration despite an episiotomy, and a smaller percentage had cervical laceration and postpartum hemorrhage. Chavanpaiboon et al. showed that the most common maternal complication after vacuum extraction is postpartum hemorrhage, as a result of macrosomic fetus and delayed second labor (29). As a result of the increased number of complications in vacuum assisted deliveries, the number of hospital days also increases. Typically, patients whose pregnancies end in spontaneous delivery without complications stay in the hospital for two days, while our study showed that over 87% of patients who delivered by vacuum extraction have more than three hospital days. From an economic point of view, spontaneous delivery is more cost-effective than assisted delivery.

One-third of vacuum-assisted deliveries required resuscitation, which is consistent with the rate reported by Simmons et al. of 25%. The most common complications occurring in neonates were pale asphyxia, livid asphyxia, cephalhematoma, clavicle fracture, and intraventricular hematoma, of which livid asphyxia and cephalhematoma were the most frequent. Chavanpaiboon reported caput succedaneum as the most common neonatal complication in the newborns delivered with vacuum extraction and stated that the rate of complications associated with vacuum-assisted delivery is low (30,31).

CONCLUSION

Vacuum-assisted delivery is a safe method of delivery, although complications associated with it are more common than in spontaneous delivery. Our study showed that primiparous women with overweight and obesity and those with abdominal circumference of 100 cm and above, are more prone to vacuum extraction. The most common maternal complication is vaginal laceration, and such deliveries require treatment of the mothers and newborns, requiring hospitalization three days or more. Neonatal complications are most often associated with cephalhematoma and livid asphyxia of the newborn.

REFERENCES

1. Sorbe B, Dahlgren S. Some important factors in the molding of the fetal head during vaginal delivery--a photographic study. Int J Gynaecol Obstet. 1983 Jun;21(3):205-12.
2. Baskett TF, Calder A. Munro Kerr's operative obstetrics. Edinburgh: Saunders Ltd, 2009.
3. Births: Final data for 2010. Natl Vital Stat Rep 2012; 61:1.
4. Menacker F, Martin JA. Expanded health data from the new birth certificate, 2005. Natl Vital Stat Rep 2008; 56:1.
5. Miksovsky P, Watson WJ. Obstetric vacuum extraction: state of the art in the new millennium. Obstet Gynecol Surv 2001; 56:736
6. Malmström, T. The vacuum extractor: An obstetrical instrument. Acta Obstet Gyncol Scand 1957; 36:5
7. Kuit J.A. Clinical and physical aspects of obstetric vacuum extraction . Erasmus University Rotterdam; 1997.
8. FDA Public Health Advisory. Need for caution when using vacuum assisted delivery devices. U.S. Food and Drug Administration: Center for Devices and Radiological Health: www.fda.gov/cdrh/fetal598.html.
9. Johanson, RB. Instrumental vaginal delivery. Guidelines and Audit Committee of the Royal College of Obstetricians and Gynaecologists, 2001.
10. Ali UA, Norwitz ER. Vacuum-assisted vaginal delivery. Rev Obstet Gynecol. 2009;2(1):5-17.
11. Vacca, A. Handbook of vacuum assisted delivery in obstetric practice, 2nd ed, Vacca Research, Brisbane, Australia 2003.
12. Johanson RB, Rice C, Doyle M, et al. A randomised prospective study comparing the new vacuum extractor policy with forceps delivery. Br J Obstet Gynaecol 1993; 100:524.
13. Ross MG, Fresquez M, El-Haddad MA. Impact of FDA advisory on reported vacuum-assisted delivery and morbidity. J Matern Fetal Med 2000; 9:321.
14. Billings, RG. The physics of vacuum extraction. OBG Manag 2004; Suppl S7.
15. Johanson R, Menon V. Soft versus rigid vacuum extractor cups for assisted vaginal delivery. Cochrane Database Syst Rev 2000; :CD000446.
16. Muise KL, Duchon MA, Brown RH. The effect of artificial caput on performance of vacuum extractors. Obstet Gynecol 1993; 81:170.
17. Liu S, Heaman M, Joseph KS, et al. Risk of maternal postpartum readmission associated with mode of delivery. Obstet Gynecol 2005; 105:836.
18. Pretlove SJ, Thompson PJ, Toozs-Hobson PM, et al. Does the mode of delivery predispose women to anal incontinence in the first year postpartum? A comparative systematic review. BJOG 2008; 115:421.
19. Johanson RB, Heycock E, Carter J, et al. Maternal and child health after assisted vaginal delivery: five-year follow up of a randomised controlled study comparing forceps and ventouse. Br J Obstet Gynaecol 1999; 106:544.
20. Smit-Wu MN, Moonen-Delarue DM, Benders MJ, et al. Onset of vacuum-related complaints in neonates. Eur J Pediatr 2006; 165:374.
21. Werner EF, Janevic TM, Illuzzi J, et al. Mode of delivery in nulliparous women and neonatal intracranial injury. Obstet Gynecol 2011; 118:1239.
22. Doumouchtsis SK, Arulkumaran S. Head trauma after instrumental births. Clin Perinatol 2008; 35:69.
23. Schot MJ, Halbertsma FJ, Katgert T, Bok LA. Development of children with symptomatic intracranial hemor-

rhage born after vacuum extraction. J Child Neurol 2013; 28:520.

24. DJ MurphyBK Strackan, R. Bahi. Guidline No.26 Assisted vaginal delivery, Royal College of Obstetrics and Gynecology (2020) doi.org/10.1111/1471-0528.16092
25. Schreiber H, Cohen G, Shalev-Ram H, Heresco L, Daykan Y, Arbib N, Biron-Shental T, Markovitch O. Vacuum-assisted delivery outcomes: is advanced maternal age a factor? Arch Gynecol Obstet. 2024 Apr;309(4):1281-1286. doi: 10.1007/s00404-023-06983-0. Epub 2023 Mar 3. PMID: 36867307.
26. Inês Martins, Diogo Ayres-de-Campos, 41 - Assisted vaginal delivery in obese women, Editor(s): Tahir Mahmood, Chu Chin Lim, Handbook of Obesity in Obstetrics and Gynecology, Academic Press, 2023, Pages 353-356, ISBN 9780323899048,https://doi.org/10.1016/B978-0-323-89904-8.00020-2.
27. Åberg K, Norman M, Pettersson K, Ekéus C. Vacuum extraction in fetal macrosomia and risk of neonatal complications: a population-based cohort study. Acta Obstet Gynecol Scand. 2016 Oct;95(10):1089-96. doi: 10.1111/aogs.12952. PMID: 27472147.
28. Åberg, Katarina (2017). Neonatal complications following birth by vacuum extraction. Karolinska Institutet. Thesis. https://hdl.handle.net/10616/46075
29. Chawanpaiboon, S., Titapant, V. & Pooliam, J. Maternal complications and risk factors associated with assisted vaginal delivery. BMC Pregnancy Childbirth 23, 756 (2023). https://doi.org/10.1186/s12884-023-06080-9
30. Simonson C, Barlow P, Dehennin N, Sphel M, Toppet V, Murillo D, Rozenberg S. Neonatal complications of vacuum-assisted delivery. Obstet Gynecol. 2007 Mar;109(3):626-33. doi: 10.1097/01.AOG.0000255981.86303.2b. PMID: 17329513.
31. Chawanpaiboon, S., Titapant, V. & Pooliam, J. Neonatal complications and risk factors associated with assisted vaginal delivery. Sci Rep 14, 11960 (2024). https://doi.org/10.1038/s41598-024-62703-x