



How are Premature Babies Born?

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ABSTRACT

The best method of delivering the preterm fetus has not been established, and there is controversy on the preferred mode of delivery (vaginal delivery versus cesarean section). However, over the past few decades, there has been a sharp rise in the cesarean section rate, particularly for premature delivery, all over the world. While the cesarean section is thought to decrease mortality and morbidity and is supposed to be the safer route for the fetus, arguments against the cesarean section can be the increased risk in the rise in cesarean sections, maternal morbidity, risks for future pregnancies, and cost. In this article, the available medical evidence on this clinical paradox is reviewed.

Keywords: Premature, vaginal delivery, cesarean section

INTRODUCTION

Throughout history, the beginning and end of life have been the most captivating concepts for humans. The discussion on how birth should take place, both scientifically and socially, has taken place since the beginning of the 20th century. The debate continues in the form of a series of reasoning that includes philosophy as well as medical science.

The most striking discourse attributed to the definition of vaginal birth is that it is a "physiological" and "natural process". Physiology is a Greek word derived from the words φύσις (physis), meaning nature or origin, and λόγος (logos), meaning system. The natural laws of the functioning of the mechanisms of living things, physical and biochemical functions and systems are physiological. Therefore, birth via vaginal delivery is a requirement of nature and systems. However, premature birth disrupts the physiological process, and how this disrupted nature will affect the flow of life is a major question, especially for scientists and for all individuals in a society. In this article, this confusing paradox is answered by means of evidence-based dialectics of medicine and sometimes by a pragmatic point of view.

A Brief History of Delivery of Premature Babies

Since genesis, as there was no other form of delivery other than via the vagina, no question was asked about which delivery method was ideal until the first cesarean section was performed. Until acceptable limitations of complications were achieved with cesarean section, no one, including scientists, had come up with an approach to deliver premature babies (1). In the 1980s, Kitchen et al. (2) began questioning the issue by reporting that premature babies should be delivered with cesarean section instead of normal birth because of intraventricular hemorrhage (IVC) and exposure to trauma. Although extensive studies have shown that this discourse does not fully reflect reality, due to the expected decrease in hypoxic stress, asphyxia, and IVC, the number of births via elective cesarean section in premature babies has sig-

nificantly increased in the last 20 years (3). Evidence-based science continues to discuss this complex issue with new perspectives and new studies from multiple windows.

Pros and cons of vaginal and cesarean section delivery

In general, when both baby and mother are concerned, vaginal delivery provides great advantages (4, 5).

Vaginal Route

Advantages for the mother

- Because it is a natural and physiological process, it is seen as fulfilling emotional integrity and maternal requirements in many societies.
- It does not involve any medication or medical aid.
- It is the most realistic and economical way.
- After birth, both the mother and the baby are discharged home early.
- The mother has less postpartum pain and quicker recovery.
- In future deliveries, labor is much more comfortable and faster.

Advantages for the baby

- After a vaginal birth, the bond between the mother and baby is more easily established, and babies are immediately breastfed.
- The mechanical reduction of fetal lung fluid during vaginal delivery helps pulmonary adaptation.
- Compared with cesarean section delivery, a newborn is less likely to develop transient tachypnea and other respiratory problems.
- Infants born vaginally are also at a decreased risk of persistent pulmonary hypertension.
- As infants born vaginally are immediately breastfed, they have an advantage in terms of symbiotic nutrition, intestinal regulation, and regulation of the immune system owing to the effect of flora obtained during delivery.



- Compared with cesarean section delivery, all the positive effects of breast milk are received much earlier and are more effective in vaginal delivery.
- In vaginal delivery, infants are less likely to develop asthma, food allergies, and lactose intolerance later in life. This may be due to being exposed to probiotic flora.

Disadvantages for the mother

- Fear of vaginal delivery due to pain or anxiety for some women.
- The mother is at risk of perineum tearing, maternal hemorrhaging, and rectal tears from vaginal delivery.
- Vaginal deliveries may increase the likelihood of pelvic organ prolapse after delivery.
- Uterus inversion may also be experienced after vaginal delivery.
- If the mother experiences a tear or episiotomy, she may have pain for the first 3 months following the birth or may develop sexual function disorders later.
- If the mother has a narrow pelvis, she may sometimes injure her tailbone during childbirth. These injuries can cause pain, fracture, or bruising of the tailbone.
- Women with vaginal deliveries have higher rates of urinary incontinence (urine leaks) than those with cesarean sections.

Disadvantages for the baby (almost all of these issues are cesarean indications!)

- The baby faces the risk of oxygen deprivation, if there is cord compression or other problems during labor and delivery.
- The baby may experience physical trauma during a prolonged labor or if the baby is large. The risk of physical trauma increases in an assisted vaginal delivery (forceps or vacuum extraction).
- However, almost all aspects related to newborn infants are evaluated within the cesarean indications.

Cesarean section

Advantages for the mother

- Planned cesarean sections may be more convenient for women because the delivery date is usually scheduled ahead of time, and the mother may have less stress and anxiety about labor.
- Compared with a vaginal delivery, scheduled cesarean sections have a reduced risk of postpartum hemorrhage and uterine atony.
- Scheduled cesarean sections have slightly lower risks of complications, including infection, accidental injury to abdominal organs, and lacerations.
- The mother may be at a decreased risk of pelvic floor injury.

Advantages for the baby

- Post-mature deliveries can be avoided with a planned cesarean section.
- If the mother has an STD (sexually transmitted disease) or an infection (such as herpes, HIV, hepatitis, and HPV), the risk of infecting her baby is greatly reduced with cesarean section.
- For babies with biophysical profile disorders, cesarean section is life-saving.

Disadvantages for the mother

- Cesarean section is a major abdominal surgery that comes with surgical risks and complications from anesthesia. Side effects of anesthesia may include severe headache, nausea, and vomiting.
- Anestezi yan etkileri (başağrısı, bulantı, kusma, vs) görülebilir.
- Mother and baby with planned cesarean sections have longer hospital stay, and there is an increased infection and complication risk for the mother.
- Cardiac dysrhythmia might be experienced.
- Hemorrhage, infection, and wound hematoma, a mass of clotted blood underneath the site of the cesarean section incision, may develop.
- Puerperal endometritis infection, an inflammation of the tissue lining the uterus caused by bacterial infection, is possible.
- Hemorrhage that requires a hysterectomy (surgical removal of the uterus) can also be experienced.
- Infection at the cesarean section site, opening of the wound, and pain may be experienced.
- In a planned cesarean section, the mother faces possible preterm delivery if her estimated due date was not correct.
- Due to hemorrhage, blood transfusion might be required.
- The mother may have bowel dysfunction after cesarean section.
- In future pregnancies, the mother is at an increased risk of developing placenta previa and placenta accreta.
- An elective cesarean section is more expensive than a vaginal birth.

Disadvantages for the baby

- Due to the side effects of anesthesia, hypotonic and respiratory distress syndrome may be seen.
- Because of the long hospital stay, the baby has an increased infection risk.
- Respiratory problems are more common in babies delivered via cesarean section. Problems include transient tachypnea of the neonate and respiratory distress syndrome.
- As breastfeeding starts later than that in vaginal delivery, the emotional bond establishment starts late, and problems pertaining to breastfeeding are more common.
- Occasionally, the baby may be nicked or cut mildly by the doctor's scalpel during cesarean section.
- Cesarean section babies are at a higher risk of persistent pulmonary hypertension.

Premature infant and premature delivery

It is noteworthy that from the adaptation to life to mortality or early period morbidity to the following periods of life, vaginal delivery has more advantages than cesarean section. However, for a premature birth that goes beyond general discourses, the findings of evidence-based medicine should be addressed. The main factors determining the mode of delivery in premature infants are gestational week (GW), presentation, fetal well-being (biophysical profile), and multiple pregnancy.

In this section, all factors affecting the mode of delivery, mortality, and morbidity in premature infants will be discussed with a review of the current literature.

Mortality

After Kitchen et al. (2) reported that small babies should be delivered via cesarean section, Malloy et al. (3, 6) stated for the first time that cesarean section has no protective effect for premature infants weighing <1500 g at birth, and it even increases the neonatal mortality among premature infants born at 32–36 GW.

Lee et al. (7) determined in their logistic regression analysis, which was based on the United States Health Statistics between 1999 and 2000, that cesarean sections increased birth survival rate in premature infants weighing <1300 g. However, they withdrew this statement after an editorial correction was published related to erroneous analyses due to gestational age-related limitations, and they reported that the mode of delivery was not associated with mortality (7-9). Lee et al. (10) found in another study, in which they studied 535,515 premature babies at 26–31 GW using the same database, that neonatal mortality was reduced by 20% in infants born with a weight in accordance with normal vaginal route GW.

Reddy et al. (11) showed in a retrospective evaluation based on the data of the National Institute of Child Health and Human Development (NICHD), in which more than 200,000 births were studied between 2002 and 2008, that the mode of delivery had no effect on the mortality of singleton premature babies at 24–31 GW, and the result did not change at different gestational ages.

In the MOSAIC Project, in which 3310 babies at 28–31 GW from 10 different European regions were studied, it was noted that cesarean sections had no effect on neonatal mortality and morbidity (12).

In a retrospective study of 57 extremely premature babies (22–27 GW), it was determined that cesarean sections had no effect on neonatal survival, especially in infants at <26 GW (13).

Alfirevic et al. (14) presented from a Cochrane database published in 2013 that a planned cesarean sections had no effect on perinatal mortality [RR 0.29, 95% confidence interval (CI) 0.07–1.14] in singleton premature infants.

In a report recently published by The American College of Obstetricians and Gynecologists (ACOG) on premature babies born on the edge of life, routine cesarean sections, especially for infants at <22 GW, except for maternal indications (uterus rupture and placenta previa), are not suggested. However, it was pointed out that for babies with detected malpresentation, an individualized delivery mode should be considered (15).

In his study on premature birth statistics between 2000 and 2003 in the United States, Malloy (16) stated that cesarean section might reduce the mortality at 22–25 GW, but a primary cesarean section could increase neonatal mortality in premature infants at 32–36 GW.

In a study conducted in Ankara by Çetinkaya et al. (17) between 2008 and 2012 on 241 babies with very low birth weights (<1500 g), it was found that when other perinatal factors were removed, the mode of delivery was not associated with mortality.

Breech Presentation and Mortality

Ingemarsson et al. (18) reported for the first time that mortality was less common in premature breech-presenting infants who

were delivered via cesarean section. In a study conducted in Israel, 692 babies at 24–36 GW with malpresentation were studied; 73% of these babies had breech presentation, and it was reported that cesarean sections prevented neonatal mortality. However, this study showed that the high rate of intrauterine fetal well-being deterioration and excessive fetal deaths in breech presentation and breech position were independent risk factors for mortality (19).

In their review articles (7 nonrandomized retrospective studies and 3557 births), Bergenhenegouwen et al. (20) reported that among premature breech-presenting infants at 25–36 GW, the neonatal mortality risk was 11.5% in vaginally delivered babies, whereas in babies delivered via cesarean section, the risk was 3.8% (RR 0.63, 95% CI 4.48-0.81). Interestingly, in the subgroup study, it was determined that in terms of mortality, the cesarean section has a remedial effect on breech-presenting preterm babies only at 25–28 GW. In a large series study sponsored by the NICHD, 2906 singleton births at 24–31 GW were examined, and it was determined that among breech-presenting infants at <28 GW, neonatal mortality was 25% for vaginally delivered babies, whereas in babies born via cesarean section, it was 13.2% ($p<0.003$). For babies at 28–31 GW, it was 6% and 1.5% ($p=0.016$), respectively (11).

In a study conducted by Bergenhenegouwen et al. (21) between 2000 and 2001, 8356 breech-presenting premature babies at 26–36⁺ GW were studied, and it was found that cesarean section had a lower mortality rate for infants at 28–32 GW.

In our country, in a 6-year study conducted by Demirci et al. (22), mortality and early morbidity rate were studied among babies with varying birth weights and delivery modes, and it was shown that mortality rate was lower only in the breech-presenting infants with 1000–1500 g birth weights who were delivered via cesarean section, but there was no difference for other premature babies.

In contrast to these results, Wolf et al. (23) reported that cesarean section did not affect mortality rate in 147 breech-presenting preterm infants at 26–31 GW. Very recently, in France, a study of 626 singleton breech-presenting premature infants at 26–29⁺ GW reported that the mode of delivery was not related to mortality (24). In a retrospective study of a very large series, 1854 premature babies who were born on the edge of life (23–24 GW) were examined, and it was determined that the mode of delivery did not affect mortality in breech-presenting babies with birth weights <500 g and in newborns intubated for 6 months (25). In a study on the effect of a scheduled cesarean section and vaginal delivery in 1543 breech-presenting preterm infants on mortality, no positive effect of a cesarean section was found (26).

When all the studies are considered, while vaginally delivered breech-presenting premature infants with 750–1500 g (26-32 GW) birth weights had a higher neonatal mortality risk, no positive effect of cesarean section in infants with a 1500 g birth weight was found.

Singleton Vertex Presentation and Mortality

Riskin et al. (27) indicated that in 2955 singleton vertex-presenting infants born with <1500 g birth weights at 24–34 GW, cesarean section did not prevent mortality after a logistic re-

gression analysis. Thus, unless an obstetric indication is present, cesarean section should not be recommended in premature babies.

Wyllie et al. (28), in a retrospective analysis of 2466 vertex-presenting babies born with <1500 g birth weights, showed that there was no positive effect of cesarean section on neonatal mortality.

Intrauterine Growth Retardation and Mortality

Werner et al. (29) showed in their study, which examined births in New York City between 1995 and 2003, that vaginal delivery did not increase mortality risk in 2885 singleton babies with (SGA) cephalic presentation who were at <25–34 GW.

Lee and Gould (10), on the other hand, found that the normal vaginal route delivery increased neonatal mortality in their study, which included 53.975 SGA premature infants at 26–31 GW.

Twin Pregnancy and Mortality

Barrett et al. (30) reported that in twin babies with cephalic presentation at 32–38⁺⁶ GW, a scheduled cesarean section has no effect on neonatal mortality and severe morbidity.

In a recent study that examined premature infants weighing ≤1500 g who were delivered via a scheduled cesarean section (n=142) and vaginally (n=51), the mode of delivery showed no effect on neonatal mortality (31).

Morbidity

Respiratory Morbidity

It is known that cesarean section is associated with increased respiratory morbidity in newborns because of the lack of impacts from normal birth that trigger hormonal and physiological lung maturation.

In the Cochrane analysis and in the National Institute for Clinical Excellence guidelines where six substantial studies were evaluated, a routine cesarean birth for premature babies is not recommended as it leads to respiratory adverse events (32, 33).

It was reported that in breech-presenting premature infants at 26–31 GW, according to Wolf et al. (23), and at 28–36 GW, according to Malhotra et al. (34), mechanical ventilation need and duration is greater in infants delivered via cesarean section.

In a review that evaluated a large series of nonrandomized studies on breech-presenting premature infants, it was reported that the incidence of respiratory distress syndrome (RDS) was high in cesarean section babies (20).

In a retrospective study on 652 premature babies at 24–30 GW between 1996 and 2014, it was found that cesarean section infants had a higher incidence of intubation and RDS (35).

In a study on early premature babies, it was found that for cephalic-presenting babies at 24–27 GW, the mode of delivery had no effect on RDS, pneumonia, and mechanical ventilation requirements; however, for babies at 28–31 GW, it was stated that cesarean section increased RDS and mechanical ventilation requirements (11).

Neurodevelopmental Prognosis

In their retrospective study, which was based on the NICHD data of 1606 babies with extremely low birth weights, Wadhawan et al. (36) reported that cesarean section did not cause a positive change in neurodevelopmental prognosis.

In a single-center, retrospective study conducted in Italy, it was emphasized that in the assessment performed on the 18-month-old babies (n=84) at <28 GW (40% of which were at <25 GW), cesarean section did not cause any improvement in terms of neurodevelopmental symptoms (37).

In the systematic review that included 2416 births in six studies and was conducted in 2013 by O'Callaghan and MacLennan (38), they stated that cesarean section did not reduce the risk of cerebral palsy in premature babies.

In a study conducted in the United Kingdom between 1995 and 2003, 213 premature babies weighing <1250 g at birth were followed up for 2 years, and it was determined that cesarean section had no positive effect on the neurodevelopmental follow-up; furthermore, at the end of 9 years, the results remained the same (39).

In another retrospective study, 3785 premature babies with extremely low birth weight (401–1000 g) were assessed after 18–22 months, and the assessment revealed that the mode of delivery had no effect on the Bayley Mental Development Index and neurodevelopmental follow-up (40).

General Morbidity - Maternal Complications

It was emphasized in the review by Bergenhenegouwen et al. (20) that the mode of delivery had no effect on premature infants in terms of umbilical pH, bronchopulmonary dysplasia, cerebral hemorrhage, and risk of infection.

Ghi et al. (41) found that the findings of intraventricular hemorrhage and white matter damage were not related to the mode of delivery in 109 preterm infants at 25–32 GW, but maternal complications were significantly higher in cesarean section deliveries.

In a recent study, it was shown that neutrophil chemotactic response was higher in premature infants born via the normal vaginal route (42).

It was stated that the intestinal flora of premature infants born via the vaginal route were different from infants delivered by cesarean section and that the mode of delivery was related to the development of necrotizing enterocolitis (NEC) (43).

Wolf et al. (23) found that the maternal morbidity of breech-presenting premature infants who were delivered via cesarean section was higher, and the length of the hospital stay was longer.

Stohl et al. (44) reported that maternal morbidities (hemorrhage and postpartum infection) were more common in mothers with fetal breech presentation and who gave birth via cesarean section.

Four randomized studies (116 cases) in which cesarean section and planned vaginal deliveries for singleton pregnancies at <37 GW in Cochrane were compared; it was determined that no difference was detected between the singleton premature

babies born via normal vaginal route and via cesarean section in terms of birth trauma (RR 0.56, 95% CI 0.05–5.62), birth asphyxia (RR 1.63, 95% CI 0.84–3.14), presence of 5th minute APGAR <7, breastfeeding, neonatal convulsion, hypoxic ischemic encephalopathy, RDS, presence of abnormal findings in childhood follow-up, birth within 7 days after hospitalization. For the mothers, no difference was found in terms of postpartum hemorrhage, wound infections, hospitalization longer than 10 days and blood transfusions. However, major maternal postpartum complications (wound opening, deep vein thrombosis, endotoxic shock and puerperal sepsis), puerperal pseudosis and other maternal infections were found to be significantly higher in cesarean mothers (14).

In a recent study, severe postpartum complications (hemorrhage, infections, intensive care need, and death) were detected in 23% of mothers of 115,502 premature babies at 24–33 GW delivered via cesarean section in 25 centers in 3 years in the US (45).

Intrauterine Growth Retardation and Morbidity

Publications in this regard are inadequate and often complicated. Cesarean section delivery at 26–31 weeks of gestation increases the chances of survival when sociodemographic and medical factors are excluded, but after the 33rd week the difference disappears; when morbidities, on the other hand, are considered, there was no difference (46).

In a study of 2885 preterm SGA at 25–34 GW with cephalic presentation, cesarean section delivery did not provide any advantage in terms of intraventricular hemorrhage, subdural hemorrhage, and convulsion and sepsis, the 5th minute <7 APGAR score and RDS risk increased (29).

The widely accepted view is that without considering fetal presentation, cesarean section decreases the mortality risk in premature babies (especially at <34 GW) with intrauterine growth retardation (IUGR). Vaginal birth should be considered only when the birth is performed and birth is inevitable. In babies without severe fetal hemodynamic impairment, induction of labor is possible with the help of appropriate obstetric conditions and fetal heart monitoring (47). However, no difference was identified related to the effect of the delivery mode on morbidity.

Breech Presentation and Morbidity

As the gestational week is smaller, the survival risk and neurodevelopmental damage risk of babies born at the border of viability (<24 GW) especially display great local differences according to perinatal care, antenatal steroids, neonatal resuscitation, delivery room, and intensive care practices. In addition, regional, ethnic and sociodemographic factors create considerable differences and great difficulties in decision-making regarding the determination of the delivery mode.

In a retrospective study of a large series about early premature infants, sepsis and mechanical ventilation need were found to be lower in 24–27 GW vaginally born babies with breech presentation, while 28–31 GW babies had a lower risk of asphyxia and higher IVH incidence (11th). In a recent study, it was found that the mode of delivery was not associated with severe morbidity in breech-presenting premature infants at 26–30 GW (24). In retro-

spective studies conducted by Tucker Edmonds et al. (25), 1854 premature babies (23–24⁺ GW) born on the edge of life in California, Missouri and Pennsylvania in the USA between the years of 2000 and 2009 were studied, and it was determined that non-emergency cesarean section delivery was associated with major morbidity (intraventricular hemorrhage, bronchopulmonary dysplasia, NEC, asphyxia).

Cephalic Presentation and Morbidity

In a study of a large series study (congenital anomalies, operative vaginal birth, <500 g and fetal growth retardation cases were excluded from the study) sponsored by the NICHD, 20,231 singleton births with cephalic presentation at 24–34 GW were examined, and the relationship between mode of delivery and neonatal morbidities were studied by means of logistic regression. It was shown that after maternal age, ethnicity, education, prepregnancy weight, gestational age, diabetes, and hypertension control, cesarean section birth increases the risk of the 5th minute APGAR <7 (OR 2.04, 95% CI 1.77–2.35) and RDS (OR 1.74, 95% CI 1.61–1.89) (48).

It has been shown that in 2906 singleton premature babies with cephalic presentation at 24–31 GW, the mode of delivery had no effect on asphyxia, IVH, NEC, and sepsis (11).

Operative Vaginal Birth and Morbidity

There is a relative contraindication of operative vaginal delivery (vacuum, forceps) below 34 GWs. According to the Swedish national birth report, vacuum extraction is used in 5.7% of premature deliveries, and intracranial hemorrhage (1.51%), extracranial hemorrhage (0.64%) and brachial plexus injury (0.64%) are more frequent compared to other modes of delivery (49).

A positive effect of prophylactic episiotomy on neonatal morbidity and mortality in premature infants has not been shown. It can only be applied in selective cases, in the presence of clinical indications such as severe perineal laceration.

Twin Pregnancy and Morbidity

Barrett et al. (30) did not detect severe neonatal morbidities in their prospective studies conducted on 1398 pregnant women (2795 fetuses) who had scheduled cesarean section births with randomized cephalic presentation and 1406 pregnant women (2812 fetuses) who had normal vaginal deliveries and twin premature babies at 32–38 GW.

As a result of twin pregnancy, in the assessment of ≤1500 g babies delivered by scheduled cesarean section (n=142) and by vaginal delivery (n=51), Barzilay et al. (31) found that while there was no difference in terms of the presence of 5th minute Apgar score <7, umbilical cord pH <7.1 and neonatal severe morbidities, the IVH risk was higher for vaginally born infants.

CONCLUSION

In the past 20 years, an excessive increase in the rates of premature babies delivered via elective cesarean section in the world as well as in our country leads to questions on the ideal mode of delivery in premature babies (50). Whereas the general approach is that the mode of delivery should not be contrary to the physiology and naturalness of life, theoretical concerns of the

physicians and families have not yet been removed because of the inadequate determination of cesarean section indications in premature infants.

The poor identification of GW and poor planning of delivery modes of premature babies make prospectivity and randomization of the studies difficult. On the other hand, since vaginal deliveries could result in immediate cesarean sections, planned cesarean section deliveries and planned vaginal deliveries could not be distinguished in studies, and this situation leads to limitations in interpretations.

Considering maternal morbidities in pregnancies where viability such as <23 GW could not be provided in addition to the chance of life and morbidity of babies, cesarean section delivery is not recommended (ACOG 2015 proposal) (15).

Cesarean section delivery may increase neonatal survival in patients with malpresentation (breech presentation) and IUGR. While cesarean section delivery has a mortality-reducing effect, especially in breech-presenting infants at 25–28 GW, for larger preterms (>32 GW) and late preterm infants, cesarean section delivery should not be considered as a routine approach.

Since a beneficial effect of elective cesarean section delivery could not be shown in preterm infants with cephalic presentation and because of the known maternal risks, cesarean section delivery should not be recommended.

Considering the slogan of the Turkish Neonatology Association, “premature babies should be born to neonatologists (doctors of the newborn babies)”, delivering premature babies in a hospital with an appropriate neonatal intensive care unit and with well-determined indications is seen as the most valid recommendation for our country.

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