

Neonatal Transfer Rate and Mode of Delivery from 37th Week of Gestation in a German Perinatal Center Level 1

Neonatale Verlegungsrate und Entbindungsmodus ab der 37. Schwangerschaftswoche in einem deutschen Perinatalzentrum Level 1

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Key words

- mode of delivery (caesarean section, forceps, vaginal delivery)
- vaginal breech delivery
- twin
- term neonate
- transfer rate to neonatal intensive care

Schlusselwort(er)

- Entbindungsmodus (Sectio, Forzeps, Spontanpartus)
- vaginale Beckenendlagen-Entbindung
- Gemini
- reife Neugeborene
- Verlegungsrate

received 28.6.2012

revised 5.2.2013

accepted 6.3.2013

Bibliography

DOI <http://dx.doi.org/10.1055/s-0032-1328435>
Geburtsh Frauenheilk 2013; 73: 324–329 © Georg Thieme Verlag KG Stuttgart · New York · ISSN 0016-5751

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Abstract



Introduction: Rates for caesarean section are on the rise and the reasons for this are being discussed worldwide. As the data is unclear, the identification of additional predictive factors for caesarean section is important as caesarean sections are closely linked to maternal and neonatal morbidity. The aim of the study was to identify predictive factors for the transfer of the neonate to a neonatal intensive care unit (NICU) depending on the mode of delivery. The study investigated the neonatal transfer rates for singleton and twin pregnancies delivered at $\geq 36 + 0$ weeks of gestation.

Material and Methods: The data of all singleton ($n = 4181$) and twin pregnancies ($n = 305$ neonates), delivered between 1 January 2009 and 31 March 2012 in the OB/Gyn Department of the University Hospital Frankfurt/M, Germany, (perinatal center level 1) were evaluated. The indications for transfer to the NICU and possible predictive factors were evaluated.

Results: Our study found a two times lower neonatal transfer rate for vaginal deliveries of pregnant women without risk factors compared to women with risk factors. The following neonatal transfer rates to the NICU were noted for singleton pregnancies: 4.7% without risk factors, 8.3% high-risk pregnancy, 6.2% vaginal breech delivery, 9.3% forceps delivery, 10% elective primary caesarean section and 14% secondary caesarean section. There was a statistically significant correlation between gestational age and transfer to the NICU ($\rho = 0.11$; $p < 0.001$). Similarly, a correlation was also found for mode of delivery (0.12; $p < 0.001$), 5 minute APGAR score (0.24; $p < 0.001$), 10 minute APGAR score (0.34; $p < 0.001$) and birth weight (0.12; $p < 0.001$).

Conclusion: Vaginal delivery resulted in a lower rate of neonatal transfers compared to caesarean section and the difference was statistically signif-

Zusammenfassung



Einleitung: Die steigende Sectio-Rate wird weltweit diskutiert. Aufgrund der unklaren Datenlage scheint die Identifikation weiterer pradiktiver Faktoren, um die Indikation fur eine Sectio zu stellen, sinnvoll und notig, da diese eng mit mutterlicher und kindlicher Morbiditat verbunden ist. In dieser Studie wird versucht, die Verlegungsrate auf die neonatologische Intensivstation von Neugeborenen ($\geq 36 + 0$ SSW) durch den Entbindungsmodus vorherzusagen. Auerdem wird nach Faktoren gesucht, die die Wahrscheinlichkeit einer Verlegung beeinflussen.

Material und Methode: Die Daten aller Einlings- ($n = 4181$) und Zwillingsschwangerschaften ($n = 305$ Neugeborene), die zwischen dem 1. Januar 2009 und dem 31. Marz 2012 in der Universitatsfrauenklinik Frankfurt am Main entbunden wurden, wurden ausgewertet. Die Indikation der Verlegung auf die neonatologische Intensivstation sowie mogliche pradiktive Faktoren wurden evaluiert.

Ergebnisse: In unserer Studie zeigte sich bei vaginalen Geburten von Schwangeren ohne Risikofaktoren eine fast 2-fach niedrigere neonatale Verlegungsrate im Vergleich zu Risikoschwangeren. Die folgenden Verlegungsraten wurden bei Einlingschwangerschaften detektiert: 4,7% ohne Risikofaktoren, 8,3% Risikoschwangerschaft, 6,2% vaginale Beckenendlagen-Entbindungen, 9,3% Forzeps-Entbindung, 10% primare Sectio und 14% sekundare Sectio. Es zeigte sich eine signifikante Korrelation der Schwangerschaftswoche mit der Verlegungsrate in die Kinderklinik ($\rho = 0,11$; $p < 0,001$). Auerdem zeigten sich weitere Korrelationen mit dem Entbindungsmodus (0,12; $p < 0,001$), 5-Minuten-APGAR (0,24; $p < 0,001$), 10-Minuten-APGAR (0,34; $p < 0,001$) und Geburtsgewicht (0,12; $p < 0,001$).

Schlussfolgerung: Die vaginale Entbindung zeigte eine statistisch signifikant niedrigere Rate an

icant. Gestational age had a statistically significant impact on the transfer rate.

neonatalen Verlegungen im Vergleich zur Sectio. Das Schwangerschaftsalter hat einen statistisch signifikanten Einfluss auf die Verlegungsrate.

Introduction

Rates for caesarean section are on the rise and the reasons for this increase are being discussed worldwide. Many causative factors have already been identified; they include maternal choice of the mode of delivery [1,2], vaginal birth after prior caesarean section [3], and breech presentation [4]. Recent studies have particularly focussed on maternal and neonatal morbidity [1,2,4–7]. Some studies have recommended elective primary caesarean section to reduce the “fear of giving birth” [8], decrease incontinence problems post partum [9] and reduce the risks associated with breech presentation [4]. Other studies have concluded that vaginal birth should be recommended because of the associated lower maternal mortality rate [10], shorter convalescence time [11], lower rate of intrauterine foetal deaths in later pregnancies [3], and lower rate of neonatal adjustment disorders [5,12–15]. As the data appear to be unclear, the identification of additional predictive factors for caesarean section is important and necessary, as caesarean section is closely linked to maternal and neonatal morbidity.

This study aimed to predict the transfer rate to the neonatal intensive care unit (NICU) for neonates (born at $\geq 36+0$ weeks of gestation) based on the mode of delivery. In addition, the study investigated factors which affected the probability of a transfer to the NICU.

Material and Methods

All singleton ($n = 4181$) and twin pregnancies ($n = 305$) delivered at $\geq 36+0$ weeks of gestation between 1 January 2009 and 31 March 2012 in the OB/Gyn Department of Johann Wolfgang Goethe University Hospital in Frankfurt (certified level 1 perinatal center) were analysed retrospectively (Fig. 1). All pregnant women included in the study were selected using the birth documentation system GeDoWin Geburt© (version 13.04); the criterion for inclusion in the study was $\geq 36+0$ weeks of gestation; the exclusion criterion was intrauterine foetal death, triplet, quadruplet. The week of gestation was calculated using the date of the last menstruation or the ultrasound investigation done in the 1st trimester. The decision for operative vaginal delivery was done in accordance with the DGGG guideline on operative vaginal deliveries [18]. The definition of a high-risk pregnancy was based on the definition given in the *Mutterpass*, the record issued in Germany to every pregnant woman by her doctor containing medical information relating to the individual woman's pregnancy.

Reasons for transfer of the neonate to the NICU were evaluated based on the diagnoses recorded in the GeDoWin Geburt©. Reasons for transfer are defined in the section on quality management in the guideline on the medical care of neonates. A paediatrician was consulted if any of the neonatal disorders listed below were present, and the paediatrician was responsible for initiating

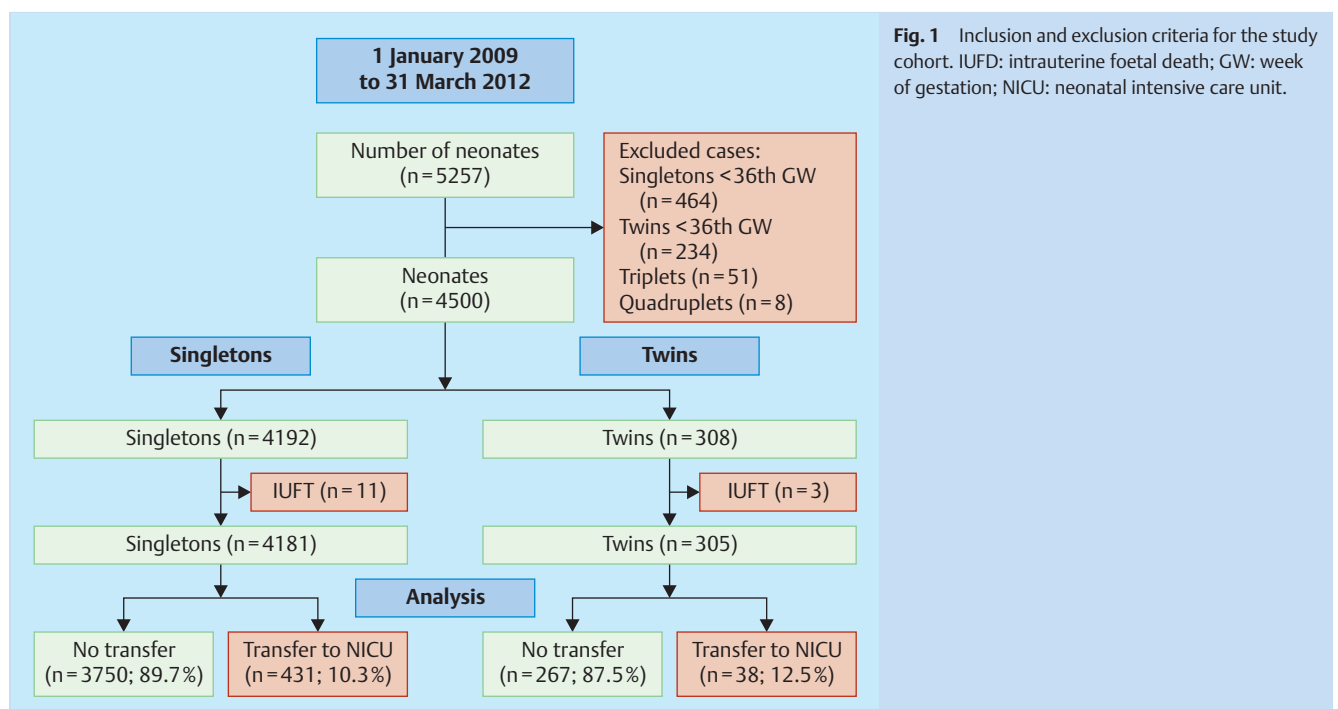


Fig. 1 Inclusion and exclusion criteria for the study cohort. IUFD: intrauterine foetal death; GW: week of gestation; NICU: neonatal intensive care unit.

all further diagnostic steps and transfer to the NICU where indicated.

- ▶ Respiratory disorders (tachypnea, dyspnea, cyanosis)
- ▶ Jaundice
- ▶ Anamnestic indications of neonatal infection (maternal fever > 38.5 °C, maternal leukocytosis, maternal CRP concentrations > 4 mg/dL, premature rupture of membranes (> 24 hours), prenatal vaginal smear (e.g. group B Streptococci in the anogenital area), peripartur maternal antibiotic administration, green amniotic fluid)
- ▶ Dystrophic neonate
- ▶ Birth weight < 3rd percentile
- ▶ Neonatal hypoglycaemia (1–24 hours of life: blood sugar “dipstick” test < 35 mg/dL; > 24 hours of life: blood sugar “dipstick” test < 45 mg/dL)
- ▶ Birth weight > 4000 g (fasting blood sugar level 2-times per day over a period of 3 days)
- ▶ Maternal HIV infection
- ▶ Cardiac arrhythmia
- ▶ Neonatal withdrawal symptoms/known maternal history of drug use
- ▶ Perinatal asphyxia (no generally authoritative definition; indications include: umbilical artery pH < 7.10, Apgar score (slight asphyxia = 1 minute score 4–7; severe asphyxia = 1 minute score 0–3), ventilation for several minutes or intubation because the neonate is not breathing independently)
- ▶ Congenital malformations
- ▶ Known maternal metabolic disorder/coagulopathy

The following potential influencing or predictive factors for a transfer to the neonatal intensive care unit of the Johann Wolfgang Goethe University Hospital Frankfurt were evaluated: duration of the birth, BMI, maternal age, gestational diabetes, mode of delivery, umbilical artery pH, Apgar scores, sex of the baby, neonatal birth weight and length, pregnancy which exceeded due date, nuchal cord/umbilical cord entanglement, protracted birth (no progress in the birth for more than 2 hours), breech presentation, prior caesarean section, maternal fever during delivery, pathological CTG, and green amniotic fluid. The data were imported retrospectively into SPSS (Statistical Package for the Social Sciences Version 17.0, IBM, Ehningen) from the perinatal records. SPSS was used to calculate mean values, standard deviations, Spearman's rho coefficient, and analysis was done using Fisher's exact test, Mann-Whitney U-test and binary logistic regression analysis. Regression analysis was used to calculate the correlation between the predicted neonatal transfer and the factors “week of gestation” and “mode of delivery”.

Table 1 Indication for neonatal transfer: comparison of singleton and twin pregnancies (Fisher's exact test).

	Singleton	Twin	p-value
HIV	31 (0.8%)	0 (0%)	n. s.
Birth weight less than 2500 g	33 (0.9%)	25 (8.2%)	< 0.001
Respiratory disorder	75 (2.0%)	5 (1.6%)	n. s.
Other infection (specific to the perinatal period)	116 (3.1%)	4 (1.3%)	n. s.
Cardiac arrhythmia	19 (0.5%)	2 (0.7%)	n. s.
Neonatal jaundice	35 (0.9%)	0 (0%)	n. s.
Neonatal withdrawal symptoms	20 (0.5%)	0 (0%)	n. s.
Severe asphyxia during birth	5 (0.1%)	0 (0%)	n. s.
Metabolic disorder/coagulopathy	18 (0.5%)	0 (0%)	n. s.
Congenital malformations	61 (1.6%)	2 (0.7%)	n. s.
Other reasons	7 (0.2%)	0 (0%)	n. s.
Total number of transferred neonates	423 (10.1%)	38 (12.5%)	n. s.
Total number not transferred	3750 (89.9%)	267 (87.5%)	–

Results

Similar transfer rates for full-term singleton and twin pregnancies

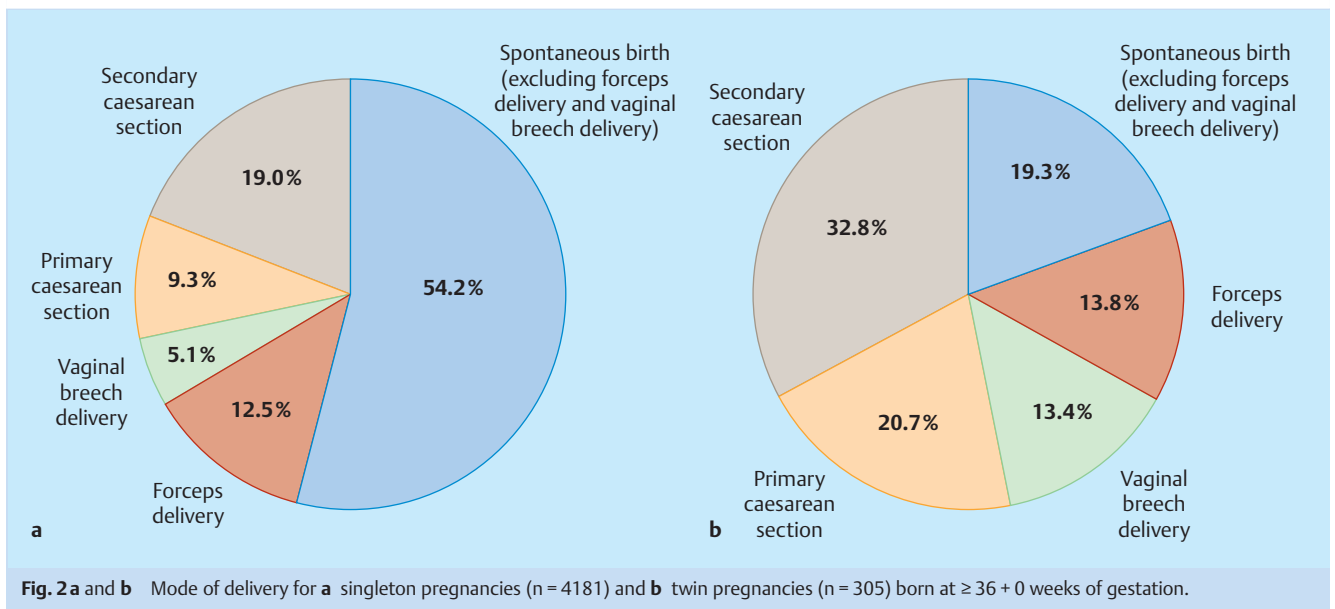
Overall, the transfer rates were similar for full-term singleton and twin pregnancies (10.1 vs. 12.5%; $p > 0.05$; **Table 1**). Only the factor “birth weight 1500–2500 g” was statistically significantly higher for twin pregnancies. In singletons, the most common reason (3.0%) for transfer to the neonatal intensive care unit was an infection specific to the perinatal period, followed by adjustment disorders in 1.9% of neonates (**Table 1**).

Neonatal transfer rates depending on the mode of delivery

Fig. 2 shows the mode of delivery for singleton and twin pregnancies in our study cohort. Pregnant women without risk factors had the lowest neonatal transfer rate with a rate of 4.7% after vaginal delivery. The neonatal transfer rate for high-risk pregnant women was almost twice as high at 8.3% ($p < 0.001$) (**Table 2**). In comparison, spontaneous vaginal breech delivery was associated with a not statistically significant, minimally increased neonatal transfer rate of 6.2% ($p > 0.05$). Forceps delivery and elective and secondary caesarean section resulted in higher neonatal transfer rates of 9.3, 10.0 (without malformations) and 14.0%, re-

Table 2 Neonatal transfer rates depending on the mode of delivery for singleton pregnancies (comparison of delivery after normal pregnancy [no high-risk pregnancy] with high-risk pregnancy, forceps delivery, vaginal breech delivery and caesarean section); (Fisher's exact test).

	Vaginal delivery		Forceps delivery	Vaginal breech delivery	Caesarean section		
	Spontaneous delivery				Primary (without malformations)	Primary (with malformations)	Secondary
	No high-risk pregnancy	High-risk pregnancy					
Transfers	45 (4.7%)	106 (8.3%)	48 (9.3%)	13 (6.2%)	32 (10.0%)	93 (24.3%)	110 (14.0%)
Total	961	1276	515	209	321	382	784
p-value	–	< 0.001	< 0.001	n. s.	< 0.001	< 0.001	< 0.001



spectively, and these higher rates were statistically significant ($p < 0.001$).

In high-risk pregnant women, only primary and secondary caesarean section resulted in a statistically significantly higher neonatal transfer rate ($p < 0.001$) (Table 2).

The neonatal transfer rates for twin pregnancies were similar to those of singleton pregnancies; the difference was not statistically significant.

Neonatal transfer rate depending on gestational age

Table 3 and Fig. 3a show neonatal transfer rates depending on the mode of delivery. A significant correlation was found between week of gestation and transfer to the neonatal intensive care unit ($\rho = 0.11$; $p < 0.001$). Transfer to the NICU was also found to be correlated to the mode of delivery (0.12; $p < 0.001$), 5 minute Apgar score (0.24; $p < 0.001$), 10 minute Apgar score

(0.34; $p < 0.001$), birth weight (0.12; $p < 0.001$), neonatal length (0.09; $p < 0.001$), sex of the neonate (0.03; $p = 0.04$) and arterial pH at birth (0.03; $p = 0.03$). No statistically significant correlation was found for “duration of the birth”, “base excess (BE)”, “maternal BMI” and “gestational diabetes” ($p > 0.05$).

Logistic regression analysis of singleton pregnancies found “week of gestation” to be statistically significant (odds ratio = 0.8; 95% CI 0.7–0.8; $p < 0.001$). Vaginal delivery had a significant negative predictive value for transfer to a NICU (odds ratio = 0.5; 95% CI 0.4–0.8; $p = 0.001$); in comparison, primary caesarean section had a significant positive predictive value for transfer to a NICU (odds ratio = 1.1; 95% CI 1.0–1.2; $p = 0.009$). Forceps delivery and secondary caesarean section had no significant predictive value for neonatal transfer ($p > 0.05$). Logistic regression analysis of twin pregnancies found no statistically significant predictive value.

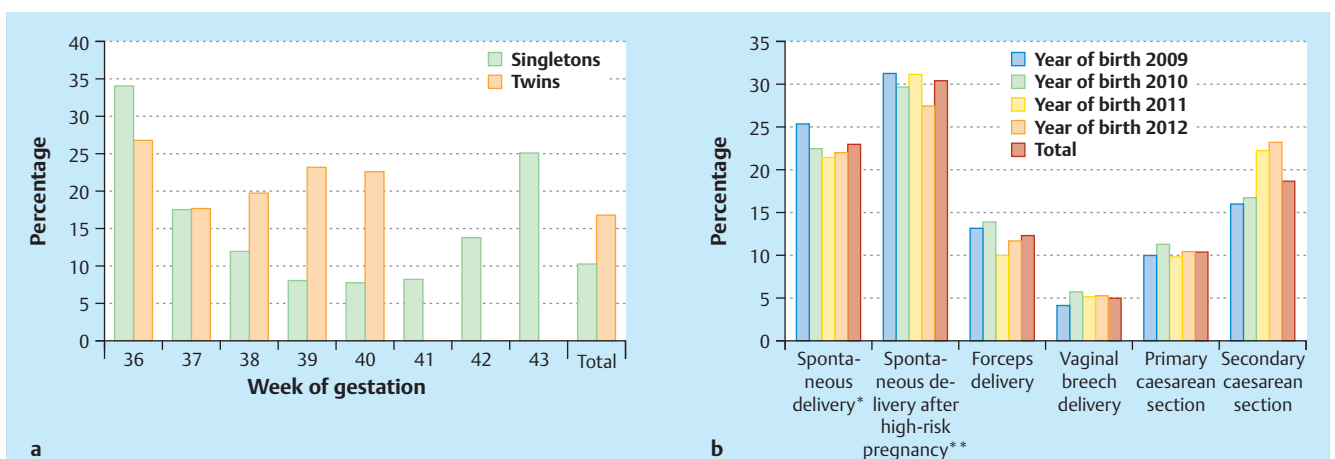


Fig. 3a and b **a** Transfer rate of singleton pregnancies (n = 4181) and twin pregnancies born at $\geq 36 + 0$ weeks of gestation depending on gestational age. **b** Mode of delivery for singleton pregnancies (2009 n = 1255; 2010 n = 1305; 2011 n = 1292; 2012 [1st quarter] n = 327) depending on the year

of birth and born at $\geq 36 + 0$ weeks of gestation; * excluding forceps delivery, vaginal breech delivery and high-risk pregnancies; ** excluding forceps delivery, vaginal breech delivery and non high-risk pregnancies.

Table 3 Neonatal transfer rates depending on gestational age.

		Week of gestation								Total
		36	37	38	39	40	41	42	43	
Singleton	Transfer to NICU (%)	34	17.5	12	8.1	7.7	8.2	13.8	25	10.3
	Total (n)	147	314	643	1 127	1 257	624	65	4	4 181
Twin	Transfer to NICU (%)	28.2	2.5	7.1	5.6	7.1				11.1
	Total (n)	39	40	42	18	14				153
Twin (2nd)	Transfer to NICU (%)	25.6	7.5	11.9	11.8	7.1				13.8
	Total (n)	39	40	42	17	14				152

NICU = neonatal intensive care unit

Mode of delivery depending on the year of birth

Fig. 3b shows the mode of delivery depending on the year of birth. A comparison of the year 2009 with the year 2011 showed a highly significant increase in the rates of secondary caesarean sections ($p < 0.001$) as well as a drop in the numbers of non-instrumental vaginal deliveries ($p = 0.04$) and of forceps deliveries ($p = 0.02$). No changes were found with respect to the rates of elective caesarean sections and of vaginal breech deliveries ($p > 0.05$).

Discussion

Our study found an almost two times lower rate of neonatal transfers to the neonatal intensive care unit for vaginal deliveries of pregnant women without risk factors compared to high-risk pregnant women.

Our results confirmed the findings of other studies [15, 19–22] which showed that elective caesarean section was associated with a higher risk of neonatal respiratory difficulties compared to vaginal delivery or attempted vaginal delivery. If other impact factors such as malformations [20, 21, 23] and high-risk pregnancies [13, 23] were excluded, the risk of neonatal respiratory distress was 2 to 3 times higher for planned caesarean sections compared to vaginal deliveries [21]. Some studies have reported even higher rates of respiratory distress in neonates delivered by caesarean section [13, 23].

Our results also confirm that gestational age had an important impact on adjustment disorders and neonatal transfer rates [5, 12–14, 20–23]. The scheduled date of the elective caesarean section should therefore be as close as possible to the due date. Some studies found that if the caesarean section was carried out prior to spontaneous onset of labour, this led to higher rates of neonatal respiratory distress [5, 14]. Although anaesthetics and surgical procedures have become much safer, the rates for maternal and neonatal morbidity and mortality are higher compared to those reported for vaginal delivery [24]. As the mortality rate for vaginal delivery vs. caesarean section is now 1 : 2.6 (caesarean section mortality is 1 : 57 300) [25, 26], the argument that maternal mortality is higher with caesarean section is becoming less and less important. However, the higher risk of morbidity specific to caesarean section remains (e.g. secondary healing), as does the increased probability for caesarean section, placentation disorder or uterine rupture with any subsequent pregnancy [26–28]. Although there are some studies on the complications of vaginal delivery, particularly urinary incontinence and faecal incontinence [29, 30], these complications require further studies and are not sufficient as an indication for caesarean section [31].

Our cohort did not reflect the increasing number of elective caesarean sections in recent years but showed instead a decrease in operative vaginal deliveries and an increase in secondary caesarean sections. Further studies will be necessary to determine whether this represents an objective trend or a subjective decision on the part of the midwife and the mother/parents, based on forensic considerations and a fear of neonatal complications with forceps delivery [28, 32, 33].

Conclusion

As long as there are no contraindication(s) for a normal vaginal delivery of the full-term infant, vaginal delivery appears to be associated with a lower risk of neonatal transfer to a neonatal intensive care unit compared to elective caesarean section. If, however, elective caesarean section is necessary, then the date of the procedure should be scheduled to be as near as possible to the due date.

Approval of the Ethics Committee

The study was a retrospective analysis of clinical data which did not affect or change the management of the patients.

Contributions of the Authors

The first author designed the study, analysed the data and wrote the first draft of the manuscript. All of the authors evaluated the results and the manuscript.

Conflict of Interest

None.

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