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Original Research

Charité Caesarean Birth Improves Birth Experience in Planned and Unplanned Caesarean Sections While Maintaining Maternal and Neonatal Safety: A Prospective Cohort Study

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Abstract

Background: In this study, we aimed to assess the safety of a modified caesarean delivery (Charité caesarean birth) in an extended frame of indications, and to examine its impact on parents' birth experience and long-term effects. **Methods**: This prospective cohort study was performed from January to June 2019. A standardized questionnaire was given to all women who gave birth as an inpatient delivery. Eight months after hospital discharge, all women who gave consent were sent a follow-up questionnaire including questions on current feelings, breast feeding, bonding, and support system, as well as a screening for postnatal depression. Indications for caesarean delivery included preterm birth, fetal malpresentation, fetal malformation, twin pregnancy, and maternal pre-existing conditions. **Results**: The study cohort included 110 women. The mode of delivery was spontaneous in 49%, per vacuum extraction in 15%, conventional caesarean section in 7%, and Charité caesarean birth in 29%. The groups with Charité versus conventional caesarean delivery did not significantly differ in neonatal admission rates, umbilical cord parameters, maternal blood loss, or duration of surgery. Compared to conventional caesarean delivery, women who underwent a Charité caesarean delivery were significantly more satisfied with their birth experience. At follow-up, the mode of delivery was not associated with significant differences in postnatal depression, breast feeding, or bonding parameters. **Conclusions**: Outside of emergency situations, Charité caesarean birth improves patients' well-being, without increased maternal and neonatal morbidity.

Keywords: birth experience; breast feeding; caesarean section; early-skin-to-skin contact; bonding; follow-up

1. Introduction

The rate of caesarean delivery (CD) is increasing worldwide, with an average of 19% in 150 countries, and higher rates in more developed countries, such as 29% in Germany in 2018 [1,2]. However, most women prefer natural birth when medically safe [3]. Therefore, parents often involuntarily miss out on having a natural birth experience to promote the safety of mother and child. Studies indicate that CD can negatively impact short-term and long-term birth satisfaction, bonding, and breast feeding [4–9]. Investigations of the association between delivery mode and postpartum maternal mental health have yielded contradictory results [10,11]. However, evidence supports that early skin-to-skin contact is crucial for successful bonding, and promotes breast feeding [12]. Women with a strong antepartum preference for vaginal delivery who deliver by CD are at increased risk of depression in the early postpartum period [13]. Thus, there is a need to both reduce the number of medically unnecessary CDs and improve birth experiences during CD.

In 2008, Smith *et al.* [14] first described the "natural caesarean", intended to introduce natural aspects of birth during CD. In healthy women with non-compromised singleton fetuses at term, "natural caesarean" allows for parental participation by dropping the surgical drape during delivery, allowing time for autoresuscitation, and promoting early skin-to-skin contact. In the following years, attempts to establish a "family-centered" or "gentle" caesarean delivery method mainly focused on early skin-to-skin contact [15–18]. Only scarce data have been collected regarding birth experiences, especially outside of planned CD [12].

"Charité caesarean birth" (CCB) is an adaption of the "natural caesarean", which was first implemented in 2012 by Prof. Henrich at the Charité Universitätsmedizin Berlin, Germany. Armbrust *et al.* [19] have demonstrated that the procedure can be safely performed in the planned CD of healthy fetuses with a gestational age of >37 weeks, excluding cases with severe known maternal morbidities. The birth experience of women receiving a CCB is reportedly significantly better compared to with a conventional caesarean section (CCS). Therefore, at our institution, the CCB has been offered to all women with an indication for planned or unplanned CD under regional anesthesia, out-

side of emergency settings. This includes cases involving twin pregnancies, fetal breech presentation, fetal malformations, and potentially even cases of maternal comorbidities and preterm delivery. Based on the high acceptance rates amongst parents, and positive experiences of obstetricians at this clinic, CCB has become the primary method of CD at our institution.

In the present study, we aimed to examine whether CCB can be safely performed in this extended frame of indications, to improve parents' birth experience, without prolonging the surgical procedure. We additionally investigated whether there might be long-time effects in terms of bonding, breast feeding, and postnatal depression.

2. Methods

2.1 Data Collection

This prospective cohort study was performed over six months at a University Perinatal Center serving both low- and high-risk patients. Ethical approval was granted (EA4/100/19). All women giving birth as an inpatient delivery, independent of delivery mode, were handed a standardized questionnaire (see **Supplemental Material**) either upon presentation at the delivery room or at the mother-child ward, by the medical documentation assistants. The questionnaire was available in the German, English, Turkish, or Arabic language, and included questions regarding the delivery mode, decision-making process, birth experience, feelings during and after childbirth (using the Salmon's Item List), breast feeding, and sociodemographic data [20,21]. The mothers were also asked if they gave consent for a follow-up interview. Completed questionnaires were collected by the ward doctors prior to the patients' release.

Approximately six months after hospital discharge, a follow-up questionnaire was sent to all women who gave consent. This follow-up questionnaire included questions about their current feelings (using the Salmon's Item List), breast feeding, bonding, and support system, as well as a screening for postnatal depression using the Edinburgh Postnatal Depression Scale (EPDS). A higher EPDS score correlates with a higher likelihood and severity of postnatal depression [22]. Women who did not return their follow-up questionnaire were contacted via telephone.

All women with an indication for a planned CD at the outpatient clinic were educated about the option of CCB during a surgical briefing approximately three to four weeks before CD. Final consent was asked just prior to surgery. In unplanned CD, the patient was given information about CCB, and asked if they gave consent for CCB by the surgeon during a surgical briefing before CD. The CCB procedure was performed as described by Armbrust *et al.* [19]. Fig. 1 presents an overview of the method according to our in-house standard operating procedure. In general, at our institution CD is performed according to an adapted version of the Misgav Ladach method based on the Joel-Cohen incision [23,24]. The uterotomy is closed by single layer continuous suture (repeat CD) or interrupted sutures (first time CD). A continuous suture is used to close the rectus sheath. The skin is closed via a continuous subcuticular suture. No stiches are performed on peritoneum or rectus muscle. Adaptions are made depending on surgeon's preferences and individual patient's characteristics. There are no differences in opening and closing techniques depending on whether CCS or CCB is performed. The CCB operating procedure is taught by superior doctors to all interns as part of their surgical training. There is a frequent briefing on the CCB in-house standard procedure for all staff involved.

2.2 Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 26.0 (IBM Corp. Armonk, NY, USA). All metric data were checked for a normal distribution based on skewness ($-1 <$ skewness < 1). Data with a normal distribution are presented as mean and standard deviation (SD). Data with a non-normal distribution are presented as median and interquartile range (IQR). Groups based on delivery mode were compared in terms of sociodemographic characteristics, rating of birth experience, Salmon's Item List variables, and other variables, using bivariate analyses with Student's *t*-tests, chi-square tests, Fisher's exact tests for small sample sizes, and Mann-Whitney U tests, as appropriate. Comparisons were made between women who experienced vaginal birth versus CD (CCB or CCS), and CCS versus CCB. Ordinal logistic regression was performed to adjust birth satisfaction according to sociodemographic data that significantly differed between birth mode groups (vaginal birth vs. CD or CCB vs. CCS). Clinical data regarding fetal outcome (e.g., cord blood gas analysis, and requirement of neonatal intensive care) and maternal outcome (e.g., blood loss and duration of surgery) were manually retrieved from the medical charts, and analyzed. Patients who were lost to follow-up were included in the initial analysis but excluded from the follow-up analysis. Patients with missing data for certain variables were excluded from analysis of those variables. We applied a two-sided significance level of $\alpha = 0.05$.

3. Results

Of the 1430 women who gave birth at the labor ward of a University Hospital during the study period, 110 (8%) completed the questionnaire and were included in this study. The mode of delivery did not significantly differ between the women included in this study (36% CD rate) and the total population of women invited to participate (36% CD rate). Questionnaires were completed in German (n = 106), English (n = 2), and Arabic (n = 2). Table 1 presents the participants' sociodemographic data.

In-house standard operating procedure for CCB. Adapted from the German language.

Inclusion criteria:

- no extension of the conventional obstetrical indications for planned and unplanned CD independent of pregnancy week
- preoperative education about method of CCB during birth planning and indication for CD

Exclusion criteria:

- rejection by woman/parents
- complicated operating site (expected increased blood loss, difficult extraction of neonate)
- general anesthesia
- emergency CD in peridural anesthesia

Procedure:

- final consent of the woman/parents during surgical team time-out
- start of CD with surgical screen up
- screen is lowered by anesthesiologic team, light averted by surgical assistant
- pause after extraction of neonate's head, slow development of neonate's thorax for compression and expulsion of amniotic fluid through oro-/nasopharynx
- cutting of the umbilical cord by father or another companion (optional)
- evaluation of neonatal adaption by surgent
    a. physiological: early skin-to-skin contact with neonate covered by warm towel established by midwife in accordance with anesthesiologic team, continuous pulse oximetry on neonate`s right hand with documentation by anesthesiologists*
    b. pathological: neonate is handed over to neonatologist for further care
- surgical screen is raised by anesthesiologic team while surgery is being completed
- midwife receives placenta and leaves operating room for umbilical cord blood measurements
- while midwife in absent a second midwife or another doctor ensures surveillance of the neonate
- upon return midwife informs surgeons, anesthesiologist and if applicable neonatologists of the umbilical cord blood measurements
- midwife returns to mother/parents for further support with positioning of the neonate, bonding and possibly first breast contact
- frequent evaluation and communication of health status of mother and child between surgeons, anesthesiologist, and midwife

*neonate stays with mother until end of surgery if Apgar Scores ≥ 7/8/9, oxygen saturation ≥ 70/80/90% (with 1, 5 and 10 minutes), heart rate > 100/min; otherwise neonate is handed over to neonatal care

Fig. 1. In-house standard operating procedure for CCB. Adapted from the German language.

Table 1. Sociodemographic data of included women according to mode of delivery (n = 110).

Variable	Vaginal birth	Vacuum extraction	Conventional caesarean section (CCS)	Charité caesarean birth (CCB)	Total	*p* (Vaginal vs. CD)	*p* (CCS vs. CCB)
	n = 54 (49%)	n = 16 (15%)	n = 8 (7%)	n = 32 (29%)	n = 110		
Age in years*[109]	31 (±5.7)	29 (±6.0)	33 (±4.3)	33 (±4.7)	31 (±5.5)	**0.018**	0.773
Gestational age in weeks*[109]	39.9 (38.6–40.6)	39.6 (38.9–40.4)	38.9 (35.9–39.1)	38.8 (38.3–39.5)	39.3 (38.5–40.3)	**0.001**	0.477
Primipara*[109]	23 (43%)	12 (75%)	2 (25%)	17 (53%)	54 (50%)	0.746	0.241[a]
Completed A-levels*[102]	34 (68%)	10 (63%)	4 (67%)	22 (73%)	70 (69%)	0.563	1.000[a]
Completed professional training*[97]	37 (79%)	13 (81%)	5 (83%)	26 (93%)	81 (84%)	0.135	0.453[a]
Working*[106]	37 (73%)	11 (69%)	4 (50%)	24 (77%)	73 (71%)	0.987	0.188[a]
Religion*[100]							
Christian	19 (41%)	5 (33%)	0	14 (45%)	38 (38%)		
Muslim	10 (22%)	0	3 (38%)	4 (13%)	17 (17%)		
None	17 (37%)	9 (60%)	5 (63%)	13 (42%)	44 (44%)		
Others	0	1 (7%)	0	0	1 (1%)		
Language at home: German*[102]	40 (80%)	14 (88%)	5 (63%)	26 (84%)	85 (81%)	0.769	0.323[a]
Country of birth: Germany*[105]	36 (71%)	12 (75%)	2 (25%)	22 (73%)	72 (69%)	0.368	**0.034**[a]
Partnership*[104]	48 (98%)	14 (88%)	8 (100%)	30 (97%)	100 (96%)	1.000[a]	1.000[a]

p-values are given for comparison between women who delivered vaginally versus per caesarean delivery (CD) (CCS or CCB), and women who delivered per conventional CCS versus CCB.

*[n], Number of women included in this subanalysis, variation due to missing data.

[a], Fisher's exact test due to small sample size.

bold data, significant results.

Table 2. Indications for caesarean delivery (CD) and maternal and neonatal outcome parameters in women with conventional caesarean section (CCS) and Charité caesarean birth (CCB).

	Conventional CS	CCB	Total	*p*
	n = 8 (20%)	n = 32 (80%)	n = 40	
Unplanned CD*[39]	2 (25%)	12 (39%)	14 (36%)	1.000[a]
Indications for CD*[39]				
Prior surgery on the uterus	4 (50%)	8 (26%)	12 (31%)	
Fetal malpresentation	0 (0%)	5 (16%)	5 (13%)	
Twin pregnancy	2 (25%)	2 (7%)	4 (10%)	
Preeclampsia	1 (13%)	1 (3%)	2 (5%)	
Fetal malformation	0	1 (3%)	1 (3%)	
Maternal pre-existing conditions	0	5 (16%)	5 (13%)	
Pathological CTG	1 (17%)	3 (10%)	4 (10%)	
Obstructed labor	0	2 (7%)	2 (5%)	
Macrosomia	0	1 (3%)	1 (3%)	
Patient's request	0	3 (8%)	3 (8%)	
Duration of surgery (min)*[34]	39 (±7)	39 (±6)	39 (±6)	0.926
Maternal blood loss (mL)[b]*[38]	500 (500–500)	500 (500–500)	500 (500–500)	0.501

*[n], number of women included in this subanalysis due to missing data.

[a], Fisher's Exact test due to small sample size.

[b], At our hospital "normal blood loss" at cesarean deliveries is reported as 500 mL unless there is a significant different amount of blood loss (significant less or peripartum hemorrhage), then the exact measured blood loss is reported in mL.

Among the women who received a CCB, CD was planned in 61% and unplanned in 39% of cases. Tables 2,3 present the indications and outcomes. Notably, CCB was performed in one case with fetal malformation (gastroschisis) and in five cases with severe maternal comorbidities (e.g., dilatative cardiomyopathy, history of cerebral aneurysm, human immunodeficiency virus, and myasthenia gravis). After CD, a total of four neonates required ad-

mission to the neonatal ward—due to premature age (n = 2), fetal malformation (n = 1), or maladjustment (n = 1).

Among women who received CCB, education about CCB was provided before or during the general surgical briefing in 22 cases (69%), and right before surgery in 10 cases (31%). One woman who received a conventional CCS reported that she had not been educated about the option of a CCB. In the event of a subsequent pregnancy, 50% (n = 15) of women who received a CCB and 63% (n = 5) of women who received conventional CCS ($p = 0.697$) reported that they would prefer vaginal birth after caesarean (VBAC), presuming there were no medical contraindications. In the event of another necessary CD, 97% (n = 30) of women who received CCB and 43% (n = 3) of those who received CCS reported that they would prefer CCB to conventional CCS.

3.1 Birth Experience

Upon questioning at the mother-child ward, women who received a CCB were significantly more satisfied with their birth experience than women who received CCS: 1 out of 6 (IQR 1–2) vs. 2.5 out of 6 (IQR 1.25–3) ($p = 0.010$) (Fig. 2). Ordinal logistic regression was performed with adjustment for sociodemographic variables that differed between CCB and CCS in univariate analysis (country of birth and religion), revealing that mode of CD was the only significant predictor of birth satisfaction: ordered log-odds (estimator) of –2.7 ($p = 0.009$). The CCB and vaginal birth groups did not significantly differ in birth satisfaction: 1 (IQR 1–2), $p = 0.491$) (Fig. 2). Again, with adjustment for the sociodemographic variables that differed between vaginal birth and CCB (age and gestational age), mode of delivery did not significantly influence birth satisfaction between the two groups: ordered log-odds (estimator) of –0.157 ($p = 0.740$). Among women who underwent unplanned CD, those who received unplanned CCB were significantly more satisfied than women who received unplanned CCS: 1 (IQR 1–2) vs. 3 (IQR 3–3) ($p = 0.040$). Again, we found no difference between women who received unplanned CCB vs. vaginal birth.

With regard to the Salmon's Item List, when asked about their feelings during birth at the mother-child ward, women who underwent a CD (CCS or CCB) felt significantly less pain than women who gave birth vaginally ($p = 0.005$). This was more apparent after CCB compared to CCS (Fig. 3A). Compared to those who had undergone vaginal birth, women who had undergone CD (CCS or CCB) felt significantly more anxious ($p = 0.023$) (Fig. 3B), and less self-determined ($p = 0.005$) (Fig. 4A). The difference in self-determination was even more significant ($p < 0.001$) between spontaneous birth and all operative modes of delivery, including vacuum extraction (VE). Women reported feeling less exhausted after CCB compared to after CCS ($p = 0.004$) (Fig. 3C). Compared to those who underwent vaginal birth, women who underwent CCB described

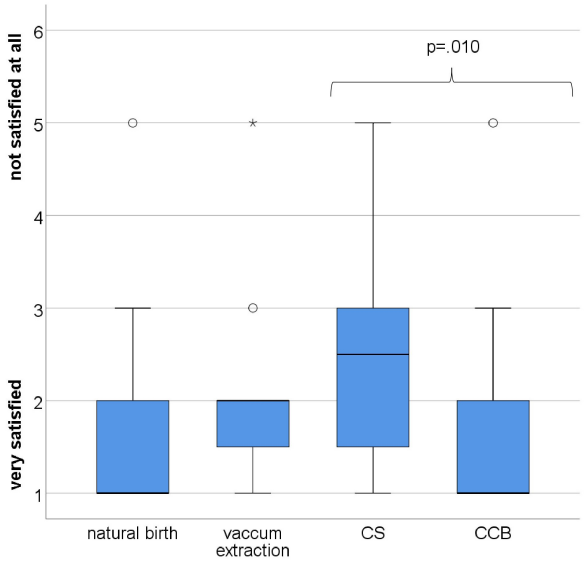

Fig. 2. Birth satisfaction. CS, conventional caesarean section; CCB, Charité caesarean birth.

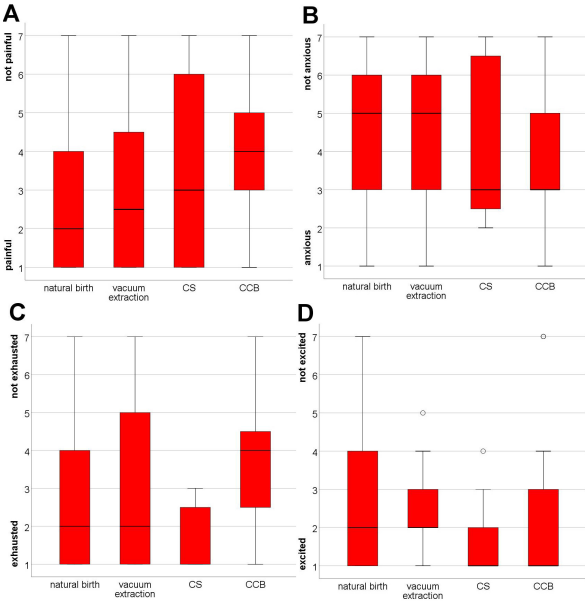

Fig. 3. Feelings during birth. CS, conventional caesarean section; CCB, Charité caesarean birth.

birth as significantly easier ($p = 0.038$), whereas there was no difference between women after conventional CCS versus vaginal birth (Fig. 4B). We found no significant differences in excitement, fulfillment, or delight between women after vaginal birth versus CD (CCS or CCB) or between women after CCS versus CCB (Figs. 3D,4C,D).

During the first days after delivery, the breast feeding rate was high in all groups and did not significantly differ according to mode of delivery: 97% after vaginal birth (n = 63), 88% after CCS (n = 7), and 93% after CCB (n = 30). Among breast-feeding women, 99% wished to continue breast feeding.

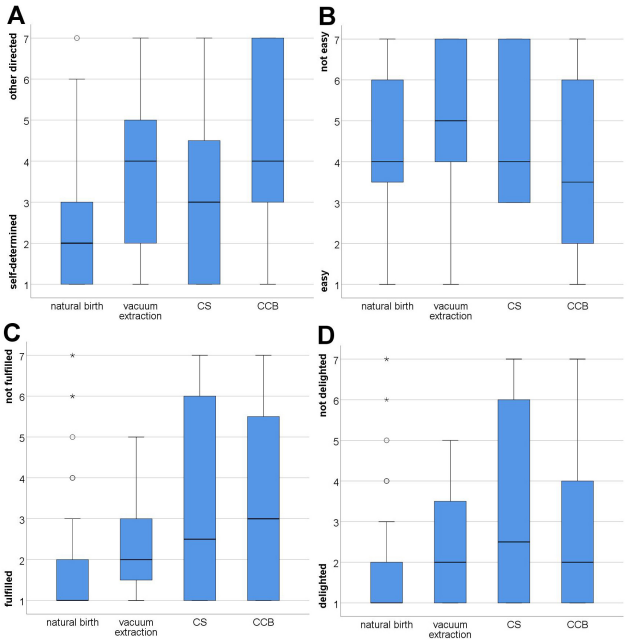

Fig. 4. Attitude towards birth. CS, conventional caesarean section; CCB, Charité caesarean birth; CD, caesarean delivery.

3.2 Follow-Up

A total of 71 women (65%) agreed to be contacted again for a follow-up interview. Among these women, 43 (39%) returned the completed follow-up questionnaire and were included in the follow-up analysis. The median follow-up time was 33 weeks (IQR 30–37). The mode of delivery did not significantly differ between the women who completed follow-up versus the primary study population: 61% vaginal birth (n = 26), 5% CCS (n = 2), and 35% CCB (n = 15).

Feelings at the time of follow-up, according to Salmon's Item List, did not significantly differ between the modes of delivery. Compared to women who received CCB, women who received conventional CS were significantly more likely to feel as if they had "missed out" ($p < 0.001$). The breast-feeding rate had dropped to 65% at follow-up, without any significant differences in the rate, or in feelings towards breast feeding, according to mode of delivery. Compared to women who had received CCB, women who received CCS more commonly felt overloaded ($p = 0.041$), and showed a non-significant trend towards less physical contact with the baby ($p = 0.054$) (Table 4).

Overall, 18 women (43%) had at least a moderately worrisome EPDS score, with no significant differences between modes of delivery (Fig. 5). However, we observed a non-significant trend towards a lower median EPDS scores after vaginal birth versus CD (CCS or CCB: 4 (IQR 1–9) vs. 8 (IQR 4–11) ($p = 0.276$).

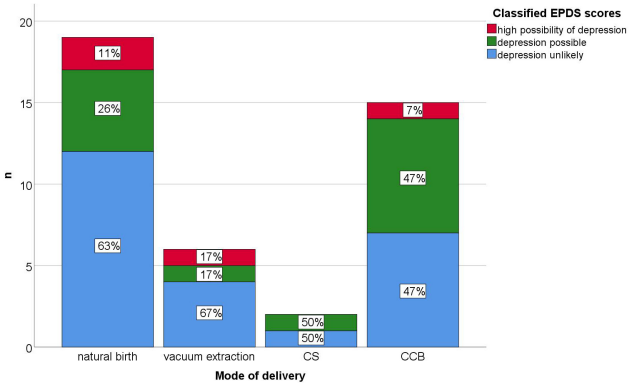

Fig. 5. Edinburgh postnatal depression scale (EPDS) score. CS, conventional caesarean section; CCB, Charité caesarean birth.

4. Discussion

To our knowledge, the present study is the first to analyze the long-term effects of CCB in an extended frame of indications. By analyzing an independent patient cohort, we were able to demonstrate that CCB can be safely conducted in both planned and unplanned CD. The indications included preterm birth, fetal malpresentation, fetal malformation, twin pregnancy, and maternal pre-existing conditions.

Few studies have assessed the safety of adapted CD methods, like CCB. One recent multicenter prospective cohort study of 243 gentle cesarean sections reported that "family-centered caesarean section" is not associated with increased risk of surgical site infections or suboptimal neonatal outcomes [25]. In our present study cohort, neonatal admission rates, umbilical cord parameters, maternal blood loss, and duration of surgery were not negatively impacted by CCB compared to CCS.

Postnatal practices after vaginal birth that contribute to greater maternal satisfaction include early skin-to-skin contact, breast feeding soon after birth, and opportunities for emotional bonding. Over recent years, these practices have been included in various forms of adapted caesarean deliveries, such as CCB. Various institutions have implemented different techniques with the aim of enabling the parents to actively participate during CD and promoting bonding. A central feature in these techniques is to immediately place the newborn skin-to-skin on the mother's chest, and to avoid separation during or immediately after CD.

Chalmers *et al.* [7] reported that in conventional CS, only 62% of women held their baby within the first hour after birth, even if the baby was not admitted to a neonatal ward. Earlier studies have shown that early skin-to-skin contact can be safely and successfully established in the operating theater [15,18,26,27]. In our present study population, 72% of women who received CCB said that their child was brought to them immediately after delivery, and in 75% of these cases, the neonates stayed on their mothers' breast until surgery was completed. After both vaginal birth and

Table 3. Fetal outcome according to mode of delivery.

Variable	Vaginal birth	Vacuum extraction	Conventional caesarean section (CCS)	Charité Caesarean Birth (CCB)	Total	*p* (Vaginal vs. CD)	*p* (CCS vs. CCB)
Premature birth*[109]	2 (4%)	1 (6%)	2 (25%)	2 (6%)	7 (6%)	0.258[a]	0.172[a]
Fetal admission to neonatal ward*[110]	3 (6%)	2 (13%)	1 (13%)	3 (9%)	9 (8%)	1.000[a]	1.000[a]
Umbilical artery base excess (NA-BE)*[101]	−5.9 (−7.3 to −3.5)	−7.0 (−10.6 to −5.4)	−2.6 (−8.8 to −2.3)	−2.6 (−4.1 to −1.5)	−4.9 (−7.1 to −2.9)	<**0.001**	0.224
Umbilical artery pH (NApH)*[107]	7.22 (±0.06)	7.17 (±0.07)	7.24 (±0.05)	7.27 (±0.05)	7.23 (±0.07)	<**0.001**	0.133
Apgar 5 minutes*[110]	10 (10 to 10)	9 (9 to 10)	10 (9 to 10)	10 (9 to 10)	10 (9 to 10)	0.245	0.857
Negative fetal outcome[b]*[108]	3 (6%)	4 (27%)	1 (13%)	3 (9%)	11 (10%)	1.000[a]	1.000[a]

*[n], number of women included in this subanalysis due to missing data.

[a], Fisher's Exact test due to small sample size.

[b], NApH <7.1; NA-BE <-10 and/or admission neonatal ward.

CD, caesarean delivery.

Table 4. Follow-up data regarding feelings towards birth, breast feeding, and bonding according to mode of delivery.

Variable	Scale	Vaginal birth	Vacuum extraction	Conventional CS (CSS)	Charité Caesarean Birth (CCB)	Total	*p* (vaginal vs. CD)	*p* (CCS vs. CCB)
Feeling of "missing out" b/c of CD*[17]	1 (no)–6 (yes)			6 (±0)	3.4 (±2.0)	3.7 (±2.1)		**0.000**
Feeling of sadness b/c of CD *[17]	1 (no)–6 (yes)			3.5 (±3.5)	2.7 (±2.1)	2.8 (±2.1)		0.625
Feeling of guilt b/c of CD*[17]	1 (no)–6 (yes)			1.5 (1–/)	1 (1–2)	1 (1–2)		0.861
Supported by partner*[36]	1 (yes)–6 (no)	2 (1–2)	1 (1–2.5)	1.5 (1–/)	1.5 (1–2)	2 (1–2)	0.497	0.929
Change in relationship due to baby*[38]	1 (pos.)–6 (neg.)	2 (±0.9)	2.8 (±1.1)	2.5 (±2.1)	2.8 (±1.3)	2.4 (±1.2)	0.154	0.781
Breast feeding*[43]	Yes	14 (70%)	4 (67%)	2 (100%)	8 (53%)	28 (65%)	0.484	0.485[a]
How well does breast feeding work?*[28 (of 28 who breast feed)]	1 (very good)–6 (very bad)	1 (1–2)	1 (1–1)	1.5 (1–/)	1 (1–1.75)	1 (1–1.75)	0.658	0.628
Is breast feeding burdensome? *[28 (of 28 who breast feed)]	1 (no)–6 (yes)	2.1 (±1.0)	1.8 (±1.3)	2.5 (±2.1)	1.7 (±1.1)	2 (±1.1)	0.743	0.477
How much physical contact do you have with your baby?*[43]	1 (several times/d)–6 (1/d or less)	1 (1–2.75)	1.5 (1–3.25)	4.75 (3.5–/)	1 (1–2)	1 (1–3)	0.715	0.054
How does the physical contact feel?*[43]	1 (good)–6 (strange)	1 (1–1)	1 (1–1)	1 (1–1)	1 (1–1)	1 (1–1)	0.866	0.715
Do you feel overloaded?*[43]	1 (rarely)–6 (often)	2.0 (±0.6)	2.0 (±1.1)	4 (±0)	2.4 (±1.0)	2.2 (±0.9)	0.526	**0.041**
How do you feel about your time at home with the baby?*[43]	1 (good)–6 (concerned)	1.5 (1–2)	1.5 (1–2)	1.5 (1–/)	1 (1–2)	1 (1–2)	0.835	0.870

*[n], number of women included in this subanalysis due to missing data.

[a], Fisher's Exact test due to small sample size.

CD, caesarean delivery.

CD, breastfeeding plays an important role in maternal attachment and in the healthy development of a child [28]. Brady *et al*. [17] reported that the implementation of skin-to-skin contact within one hour of CD resulted in an increase of the breast-feeding rate from 8% to 19%. In our cohort, breast-feeding rates did not significantly differ between modes of delivery, which might be explained by the already high rate of >90%.

Our present results show that women who received CCB were significantly more satisfied with their birth experience compared to women who received CCS. This is in line with prior research concerning CCB for planned CD [19]. Furthermore, in our cohort, satisfaction with the birth experience was equal after CCB and after vaginal birth. Chalmers *et al*. [7] reported that women were likely to rate their birth experience as less positive after conventional CS compared to after vaginal birth.

Compared to women in the vaginal birth group, women who received CCB perceived significantly less pain, while no reduction of pain perception was found in the CCS group. This might suggest that CCB positively influences pain perception. Correspondingly, data have shown that early skin-to-skin contact in the operation room reduces pain [18]. The fear of pain and anxiety regarding upcoming surgery are associated with an increased risk of early postnatal depression after CD [29]. Notably, women reported feeling significantly less exhausted during CCB compared to during CCS. The CCB and CCS groups did not significantly differ in other emotional parameters, such as self-determination and anxiousness, in our study. Additionally, the mode of CD did not significantly influence the desire for VBAC in a future pregnancy—50% of women who received CCB and 63% of those who received CCS would prefer VBAC if medically possible. Following the implementation of CCB at our clinic, the rate of CD did not increase and fluctuated between 34% and 36.5%, which can be explained by our high-risk group.

Follow-up analysis revealed that postnatal depression, breast feeding, and bonding parameters did not significantly differ between modes of delivery. Generally speaking, women were more commonly classified as "depression possible" or "high possibility of depression" after CCB compared to after vaginal birth (57% versus 37%); however, this difference was not statistically significant. The literature reveals no link between CD and postpartum depression [30–32]. In an Iranian study, at four months after delivery, the postpartum depression prevalence rates were 14.5% after vaginal delivery and 16.7% after CD, which were not significantly different [33].

Our study had several limitations that must be considered. The patient was able to choose whether to receive CCB after informed consent; however, the final decision was ultimately made by the individual obstetrician. An ideal study would require randomization, ignoring the informed patient's wishes [34]. Another potential weakness of the study is the small sample size, which gives us low statistical power to detect an increased risk of major complications and an influence on long-term effects. The participation rate for our study was only 8%, possibly indicating a selection bias. Additionally, although we distributed the questionnaire in four different languages, we received few non-German completed questionnaires, which might indicate a selection bias towards German-speaking women [35].

The rate of CD in our study population did not differ from the general CD rate at our university center during the study period. In our study population, the rate of CCS (7%) was much lower than that of CCB (29%), impeding statistical comparison between the two groups. This different might be caused by a selection bias towards women who received CCB. However, in our experience as surgeons at this clinic, the majority of CD are now performed as CCB rather than conventional CS, due to the positive experiences that our team has had with the procedure and the high demand by our patients.

Our lost-to-follow-up rate was 61%. Therefore, the follow-up data might not have been sufficient to identify any significant long-term effects of CCB versus CCS, especially since the follow-up respondents included only two women who received CCS.

5. Conclusions

When CD modifications are introduced, it is imperative to preserve safety and prevent negative long-term effects. In agreement with pre-existing literature, our present results show that CCB can be safely performed outside of emergency situations, for both planned and unplanned CD, with the parents' consent, to improve women's birth satisfaction. After eight years of successful implementation of the CCB, with a stable rate of CD, we are convinced that CCB should be the standard of care for medically indicated CD going forward. Notably, through careful parents' education, this shift should not lead to an increased rate of elective CD. CCB holds promise for optimization of management at the theater, by improving the patients' well-being without increasing maternal and neonatal morbidity. Randomized controlled trials are needed to substantiate our findings.

Author Contributions

LR collected the data, created and translated the questionnaire, performed the analysis, and wrote the manuscript. RD, CB contributed to the analysis and to the final version of the manuscript. AP, KS created and translated the questionnaire, and contributed to the final version of the manuscript. CK conceived the study, created the questionnaire, and contributed to the final version of the manuscript. WH contributed to the final version of the manuscript, and supervised the project. AMD conceived the study, created the questionnaire, and contributed to the analysis and to the

final version of the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

The study was performed in accordance with the principles of the Declaration of Helsinki. It was approved by the local Institutional Review Board (Ethikkommission Charité, EA4/100/19), and all participants provided written informed consent to participate and for publication.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/j.ceog4906124.

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