

The impact of cesarean section on neonatal outcomes at a university based tertiary hospital in Jordan

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Abstract

Background Despite the WHO recommendation for cesarean section rates not to exceed 15% to minimize negative consequences in the mothers and neonates, there continues to be a steady rise in its rate globally. As a result, short-term and long-term maternal and neonatal complications are rising. The objective of this study is to determine the rate and assess neonatal outcomes of cesarean section at King Abdullah University Hospital (KAUH) in Jordan.

Methods A retrospective chart review of all mothers and neonates delivered by cesarean section during the period January 2016 to July 2017 at KAUH tertiary academic center.

Results 2595 Cesarean deliveries were performed over 18 months representing a rate of 50.5% of all deliveries. 60% were scheduled procedures. 72% were performed at full term gestation. The most common indication was previously scarred uterus followed by fetal distress. Rate of admission to the neonatal ICU was 30% (800/2595). After multilogistic conditional regression analysis, the factors associated with increased risk of neonatal ICU admission include grandmultiparity (Adjusted OR 1.46), gestational diabetes (Adjusted OR 1.92), maternal employment (Adjusted OR 1.84), prolonged rupture of membranes (Adjusted OR 5), fetal distress (Adjusted OR 1.84), prematurity (Adjusted OR 43.78), low birth weight (Adjusted OR 42), high order multiple gestation (Adjusted OR 9.58) and low 5-minute APGAR score (Adjusted OR 10). One out of six babies born at early term (37-38.6 weeks) were admitted for a median length of stay of 4 days (IQR 2, 8), the most common diagnosis was transient tachypnea of newborns and respiratory distress syndrome.

Conclusion CS deliveries account for more than half the number of deliveries at our institution and one third of the delivered babies get admitted to the NICU. Together with the resulting maternal and neonatal consequences, this carries a major burden on the newborns, health care facilities and involved families. Local strategies and policies should be established and implemented to improve the outcome of births.

Background

Cesarean section (CS) is the most commonly performed surgical procedure in obstetrics (1). In the past, CS was performed for pure obstetric indications where vaginal delivery carries risks on the mother and the baby. The World Health Organization (WHO) has repeatedly reported any population-based rate of CS delivery should not exceed 15% (2). With the advance in anesthesia and postoperative care over the past one to two decades, the rate of cesarean section rose all across the world with a variable reported rate of 15–40% amongst different nations and institutions (3,4). Although not well understood, multiple factors have contributed to this uptrend. Maternal indications for CS include previous CS delivery, antepartum hemorrhage, uncontrolled hypertension, and failure to progress of labor (5). Fetal indications include fetal distress, malpresentation, cephalopelvic disproportion and certain major congenital anomalies (5). The goal of CS delivery is to avoid the complications that might develop after vaginal delivery. However, this major surgery is not without significant impact on maternal and fetal/ neonatal outcomes. Previous

studies have reported an increase in maternal mortality up to three times with CS delivery (1). Similarly, the rate of maternal complications increases two and five folds after elective and emergency CS respectively (1). Maternal complications include the increased risk of postpartum hemorrhage, risk of hysterectomy, infection and deep venous thrombosis besides longer hospital stay and increased risk in subsequent pregnancies. Data about the effect of increasing CS rate on reducing neonatal complications is conflicting between different centers (6–8). Besides the increase in mortality rate, fetal and neonatal complications include the increased risk for neonatal ICU admission, respiratory morbidities and mother-infant separation with all its consequences. (9). In 2016, Kupari et al from Finland concluded that the increase in CS rate does not lower the incidence of neonatal asphyxia. Rather, the rate of NICU admissions was higher after CS deliveries in their review (10). More recently, studies have supported the use of antenatal steroids to reduce respiratory morbidities among babies born by elective CS at late preterm and term gestation. (11–13).

In Jordan, few studies have been published over the past decade indicating national increase in the rate of CS delivery (14)(15). However, neither the rate of CS delivery nor the resultant maternal and fetal/neonatal outcomes have been specifically studied in the past at any of the academic hospitals where resident trainees are more involved and so we decide to conduct this project to shed light on our outcomes as a university based tertiary care center.

Methods

The objective of this study is to determine the rate and indications of CS delivery at KAUH and assess neonatal outcomes including NICU admission rate, respiratory morbidities, sepsis, mortality and length of hospitalization.

A retrospective chart review was conducted for all CS deliveries at KAUH in Jordan in the period January 2016 to July 2017. KAUH is a university-based tertiary care center affiliated with Jordan University of Science and Technology. It is located in the city of Irbid and provides health service to nearly two millions of the Jordanian population. Most of our patients have governmental and employer-based health insurance. The number of annual deliveries approaches 3500. The obstetric service is run by ten full time consultant obstetricians with around 30 postgraduate training residents.

The list of all CS deliveries during the study period was extracted from the hospital electronic database. An Institutional Review Board (IRB) approval was obtained from Jordan University of Science and Technology. Patient's consent was waived. Data collected includes maternal demographics, past obstetric history, associated medical problems, type of CS (elective vs emergency), indication for delivery, type of anesthesia, newborn outcomes including birth weight, 5-minute Apgar score, NICU admission, respiratory status, the need for respiratory support, rate of sepsis and length of stay

Data was collected by well-trained postgraduate residents under the supervision of the principal investigator who is a consultant neonatologist. Data was collected in an excel sheet and completed for

more than 99% of the included women and their newborns. Neonatal outcomes were based on the diagnoses assigned by the treating neonatologist as documented in the electronic medical records.

Statistical analysis

SPSS version 22 was used for data management and analyses (IBM Corp., Armonk, N.Y., USA). Frequency distribution (numbers and percentages) and mean (SD) were produced for all variables as appropriate. At the bivariate level, distribution of each independent variable by the outcome of NICU admission was assessed using X^2 test or t-test, as appropriate, along with P-values. Variables that were associated with admission were then included in a backward conditional logistic regression level (entry level: 0.05, removal level: 0.2). Variables identified by the regression model were presented using Adjusted Odds Ratios and 95% Confidence Intervals (AOR, 95% C.I.). Alpha level was set at 0.05.

Results

During the study period, 2595 CS deliveries were performed at KAUH. This represents 50.5% of all deliveries. Of the CS deliveries, 60% were electively planned procedures among term and late preterm pregnancies and 40% performed as emergency deliveries. Table No. 1 shows the maternal and neonatal characteristics of the studied population. 72% of CS deliveries were performed at full term gestation and 13% of cases were multiple gestation pregnancies. General anesthesia was used in almost one third of the cases.

The main indication for CS delivery was previous CS delivery (43%) followed by fetal intolerance to labor (15.5%), maternal request (14.9%) and failure to progress (6%). Nearly 10% of CS deliveries were performed after failure of labor induction trial Table No. 2.

A total of 800 neonates were admitted to the neonatal Intensive Care Unit (NICU) following CS delivery. Of those, 43% (346) were born at full term gestation. The rate of NICU admission was 23% among the elective procedures compared with 43% in the emergency CS deliveries.

The factors associated with increasing risk of NICU admission among CS delivery, as reported in table No. 3, were then included in a backward conditional logistic regression model (entry level: 0.05, removal level: 0.2). With this logistic regression model, the following factors were found to be significantly associated with increased rate of NICU admission.

Maternal factors

Parity status: Increased rate among grand multiparous (≥ 3) mothers (AOR 1.46)

Maternal morbidities: Increased rate among mothers with gestational diabetes (AOR 1.92).

First time CS delivery (AOR 1.45)

Mothers with prolonged rupture of membranes before delivery with clinical suspicion of chorioamnionitis (AOR 5.0).

Maternal employment (AOR 1.84)

Fetal/ neonatal factors

Emergency procedures due to fetal distress (AOR 1.84).

Prematurity (AOR 2.34 for 35–37 weeks and 43.78 for < 35 weeks).

Low birth weight (AOR 42 for < 1500 grams and 2.22 for 1500–2500 grams)

High order multiple gestations (≥ 3) (AOR 9.58).

Low APGAR score at 5 minutes (AOR 10).

Table No. 4 shows the outcomes of the neonates admitted to the NICU. Among the neonates admitted to NICU, more than half required respiratory support for at least 24 hours. Of the 459 admissions who required respiratory support in the form of continuous positive airway pressure (CPAP) or invasive mechanical ventilation for diagnosis of respiratory distress syndrome or transient tachypnea of newborn, 139 (30%) were term babies of whom two thirds (88/139) were born by elective planned CS between 37 and 38 6/7-week gestation. 126/800 (16%) received surfactant (24 term vs 122 preterm), 18% of NICU admissions were complicated by sepsis. The mortality rate was 5%.

Discussion

Our study demonstrates high rate of CS delivery exceeding half of all the deliveries at our institution. Almost one third of the delivered neonates were admitted to the NICU. This high rate could be related to the fact that KAUH is a referral tertiary center with a high rate of high-risk pregnancy referrals and the presence of IVF center.

Globally, there has been an uptrend in the rate of CS deliveries over the past two decades. A recent report published in 2016 showed an increase in CS rate from 20 to 42% in Latin America and 14 to 25% in Europe (3).

In the US, the CDC reports about CS delivery have shown a national increase in CS rate over the past few years reaching as high as 38% in the southern states (16).

Among the factors that could have contributed to this global increase in the rate of CS procedure are patient expectations regarding the safety of labor, improved maternal education and economic status increasing maternal demand for CS delivery, the fear of malpractice claims, and the limitations or lack of experience in technology in assessing the risk of vaginal delivery (17).

In Jordan, a national study published in 2017 reported a CS rate of 29% among different Jordanian hospitals (15). In their study, Batieha et al reported a higher rate of CS in teaching and private hospitals, they also reported higher rate of CS with previously scarred uterus and fetal distress. The neonatal mortality rate was also higher compared with vaginal births. Ten years earlier, the rate of CS was about 18% as reported by Department of Statistics (Jordan) and Macro International Inc. 2008 (18). Factors that could possibly explain the higher rate in teaching and private hospitals include performing

unindicated operations for the purpose of training the resident doctors or strictly for better financial gain (14).

The indications for CS deliveries among our patients are consistent with other international reports (3,14,19). The main reported indication of CS in our study is a scared uterus. This was the main medically approved indication in the majority of other studies. This factor should draw the attention of all decision makers to review the indication of the first time CS and make sure it is medically indicated since this is the main determinant for repeat sections in the future especially in places where large family size is preferred and could be potentially limited with repeated CS deliveries.

The increase in maternal request for elective CS in the absence of any medical or obstetric indications has added to the rising rate of CS in multiple centers (20). In our study, maternal request accounted for about 15% of the CS procedures. On the contrary, this has not been of a great concern in Canada and Switzerland where the obstetricians stick to the local guidelines and don't perform CS solely upon maternal request (21). More detailed counselling should be provided to expectant mothers about the short and long-term consequences of this procedure, obstetricians need to focus on medical indications during their discussion and guide the pregnant women in making the decision.

The increasing rate of IVF procedures and other reproductive interventions resulting in multiple gestations has also contributed to higher CS rate in tertiary centers(21)

Although emergency CS procedures are intended to lower maternal and neonatal mortality and morbidities, it is clear that CS delivery might be associated with negative short-term and long-term consequences. This has been reported in several studies across the world with prolonging postpartum pain, analgesic intake, and hospital stay as well as increasing rate of NICU admissions with all resulting social and financial burdens. (21–23).

Our study showed the rate of NICU admission to be about 30% for all groups and 19% among term births. Of the NICU admissions, nearly 45% were born by a planned CS delivery after 35-week gestation. Term babies constitute about half of NICU admissions, of whom two-thirds (234/346) were born between 37 and 38.6 weeks. The main indication for admission of term babies is for respiratory support secondary to delayed transitioning and the median length of stay among this group of babies is 4 days (IQR 2, 8 days).

Regarding neonatal outcomes, our findings are consistent with several other studies reporting an increase in respiratory morbidity among term babies born by planned CS (24,25). This can be explained by the fact that fetal lung fluid clearance is delayed or impaired after planned CS deliveries without going through labor first (26). In our cohort, almost one third of the neonates admitted to the NICU were given a 2 to 3-hour chance of transitioning in the newborn nursery before getting transferred to the NICU for respiratory support.

The respiratory outcomes of term neonates are not only reported to be worse after CS delivery when compared to vaginal birth. Rather, the exact gestational age plays an important role on the outcome of

these babies. Studies have reported a better outcome for neonates delivered by elective CS if the procedure is performed after completed 39-week gestation (27,28).

Our study showed that about one out of 4 babies delivered by a planned scheduled CS after 35 weeks' gestation was admitted to the NICU. We have also noticed that 63% (988/1557) of planned CS deliveries among term babies were performed between 37-38.6 weeks and the rate of NICU admission among this group in particular was 16% (159/988). Same finding of high rate of NICU admission among early term CS deliveries was reported by Wilmink from Netherlands (29) which emphasizes the importance of avoiding elective CS before 39 weeks.

Salemi et al found that the outcome of early term delivery is significantly worse among neonates born by elective CS when compared to those born after labor induction (30). This concludes that adverse neonatal respiratory outcomes could be potentially decreased not only by avoiding CS delivery but also by the advancing GA even in the full term category. The compliance with the ACOG recommendations regarding avoiding early term delivery should be strongly encouraged to avoid such unwanted complications (31). Although delayed transitioning and TTN are considered benign, the social and financial burdens of having babies admitted to the NICU for few days should not be underestimated (27,28).

Another downside of CS delivery that is not focused on by most studies is the decline in breastfeeding rate in those neonates compared with vaginal birth. In 2017, we have published a study about predictors and barriers to exclusive breastfeeding in Jordan and found a strong negative association between breastfeeding trends and CS delivery (32).

The main limitation of our study is the retrospective chart review nature which makes it difficult to accurately infer conclusions. Also, the reasons for performing CS procedures were primarily provided by the obstetrician who is likely to provide reasonable justifications for performing CS although this may not reflect the actual indications.

Conclusion

In conclusion, the rate of CS delivery is trending up and this has contributed to the increase in NICU admissions resulting in significant medical, social and financial impacts in the involved families and health care facilities. Major hospitals and academic institutions should implement strategies and policies and strictly emphasize on following them to avoid any bias in selecting the mode of delivery in order to improve the outcome of births. Application of monitoring pathways should be established at the level of national health agencies.

Abbreviations

KAUH: King Abdullah University Hospital

NICU: Neonatal Intensive Care Unit

CS: Cesarean Section

WHO: World Health Organization

ACOG: American College of Obstetrics and Gynecology

RDS: Respiratory Distress Syndrome

TTN: Transient Tachypnea of Newborns

Declarations

Ethics approval and consent to participate: An Institutional Review Board (IRB) approval was obtained from Jordan University of Science and Technology (IRB number 388-2017). Patient's consent was waived as this study involves chart review.

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: All authors declare that they have no competing interest.

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Authors' contributions: WK contributed to study ideation, data collection and analysis, and manuscript drafting. DY contributed to data collection and manuscript writing. JA contributed to data analysis and manuscript writing.

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Tables

Table no. 1 Maternal and neonatal characteristics

		Number (N=2595)	Percent
<u>Maternal</u>			
-			
Age (years)	≤ 21	57	2.2%
	21 to 35	1,930	74.4%
	≥ 35	608	23.4%
Parity	1	643	24.8%
	2	1,172	45.2%
	≥ 3	780	30.1%
IVF	No	2,361	91.0%
	Yes	234	9.0%
Preeclampsia	No	2,541	97.9%
	Yes	54	2.1%
Gestational DM	No	2,526	97.3%
	Yes	69	2.7%
Previous CS	No	1,072	41.4%
	Yes	1,520	58.6%
Employed	No	801	30.9%
	Yes	1,794	69.1%
AN steroids	No	2,107	81.3%
	Yes	486	18.7%
Induction trial	No	2,335	90.1%
	Yes	256	9.9%
PROM	No	2,301	88.8%
	Yes	290	11.2%
Elective	No	1,036	40%
	Yes	1,557	60%
Anesthesia	General	805	31%
	Spinal	1790	69%
-			
<u>Neonatal</u>			
Gestational age	≤ 35	259	10%

(weeks)	35 to 36	471	18.2%
	≥ 37	1,865	71.9%
Birth Weight (grams)	Mean (SD)	2910 (630)	-----
	≤ 1500	90	3.5%
	1501-2500	496	19.1%
	≥ 2500	2009	77.4%
Gender	F	1,235	47.6%
	M	1,360	52.4%
Multiples	Singleton	2,269	87.4%
	Twins	258	9.9%
	Triplets	57	2.2%
	Quadruplets	11	0.4%
5-min APGAR	≤ 7	66	2.5%
	≥ 7	2,529	97.5%

IVF: In Vitro Fertilization

DM: Diabetes Mellitus

CS: Cesarean section

PROM: Prolonged rupture of membranes

(SD): Standard deviation

F: Female, M: Male

Table No.2 Indications for CS

Indication	Number	Percentage
Previous CS/ No VBAC trial	1108	42.8 %
Fetal distress	402	15.5 %
Maternal request	386	14.9 %
Breech presentation	199	7.7 %
Failure to progress	164	6.3 %
Multiple gestation	157	6.1%
Preeclampsia	90	3.5%
Antepartum hemorrhage	83	3.2%
others	2	0.1%

CS: Cesarean Section

VBAC: Vaginal birth after cesarean section

Table no. 3 Risk factors for NICU admission following CS delivery

		N (%)	P value	AOR	95%	Conf Interval
Age (years)	≤ 21	23 (2.9)	0.287	-----		
	21 to 35	589 (73.6)				
	≥ 35	188 (23.5)				
Parity	1	254 (31.8)	0.000	Ref	0.86	1.74
	2	305 (38.1)				
	≥ 3	241 (30.1)				
IVF	No	667 (83.4)	0.000	-----		
	Yes	133 (16.6)				
Preeclampsia	No	771 (96.4)	0.000	-----		
	Yes	29 (3.6)				
Gestational_DM	No	768 (96)	0.004	Ref	1.05	3.53
	Yes	32 (4)				
Previous_CS	No	441 (55.1)	0.000	Ref	0.49	0.99
	Yes	358 (44.9)				
Employed	No	206 (25.8)	0.000	Ref	1.44	2.34
	Yes	594 (74.2)				
Induction trial	No	720 (90)	0.472	Ref	0.41	0.93
	Yes	80 (10)				
PROM	No	613 (76.6)	0.000	Ref	3.6	6.9
	Yes	187 (23.4)				
Anesthesia	GA	296 (37)	0.000	-----		
	Spinal	504 (63)				
G age (weeks)	≤ 35	249 (31.1)	0.000	43.78	21.21	90.37
	35 to 36	205 (25.6)				
	≥ 37	346 (43.3)				
Birth weight	≤ 1500	90 (11.3)	0.000	42.01	19.08	88.44
	1501-2500	285 (35.6)				
	≥ 2500	425 (53.1)				
Gender	F	377 (47.1)	0.383	-----		
	M	423 (52.9)				
Multiples	Singleton	605 (75.6)	0.000	Ref	0.35	0.96
	Twins	128 (16)				
	Triplets	56 (7)				
	Quadruplets	11 (1.4)				
APGAR 5min	≤ 7	59 (7.4)	0.000	10.01	4.07	24.60
	≥ 7	741 (92.6)				

NICU: Neonatal intensive care unit

IVF: In Vitro Fertilization

DM: Diabetes Mellitus

CS: Cesarean section

PROM: Prolonged rupture of membranes

G age: Gestational age

M: Male, F: Female

Table No. 4 Neonatal outcomes of NICU admissions

		Number	Percent
Direct Admission	No	271	33.9%
	Yes	529	66.1%
TTN/ RDS	No	359	44.8%
	Yes	441	55.2%
CPAP	No	354	44.2%
	Yes	446	55.8%
Surfactant	No	674	84.5%
	Yes	126	15.5%
Sepsis	No	655	81.9%
	Yes	145	18.1%
Mortality	No	760	95.0%
	Yes	40	5.0%

NICU: Neonatal intensive care unit

TTN: Transient tachypnea of the newborn

RDS: Respiratory distress syndrome

CPAP: Continuous positive airway pressure