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Comparison of Transverse and Vertical Skin Incision for Emergency Cesarean Delivery

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Abstract

OBJECTIVE—To compare incision-to-delivery intervals and related maternal and neonatal outcomes by skin incision in primary and repeat emergent cesarean deliveries.

METHODS—From 1999 to 2000, a prospective cohort study of all cesarean deliveries was conducted at 13 hospitals comprising the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development's Maternal-Fetal Medicine Units Network. This secondary analysis was limited to emergent procedures, defined as those performed for cord prolapse, abruption, placenta previa with hemorrhage, nonreassuring fetal heart rate tracing, or uterine rupture. Incision-to-delivery intervals, incision-to-closure intervals, and maternal outcomes were compared by skin-incision type (transverse compared with vertical) after stratifying for primary

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compared with repeat singleton cesarean delivery. Neonatal outcomes were compared by skin-incision type.

RESULTS—Of the 37,112 live singleton cesarean deliveries, 3,525 (9.5%) were performed for emergent indications of which 2,498 (70.9%) were performed by transverse and the remaining 1,027 (29.1%) by vertical incision. Vertical skin incision shortened median incision-to-delivery intervals by 1 minute (3 compared with 4 minutes, $P<.001$) in primary and 2 minutes (3 compared with 5 minutes, $P<.001$) in repeat cesarean deliveries. Total median operative time was longer after vertical skin incision by 3 minutes in primary (46 compared with 43 minutes, $P<.001$) and 4 minutes in repeat cesarean deliveries (56 compared with 52 minutes, $P<.001$). Neonates delivered through a vertical incision were more likely to have an umbilical artery pH of less than 7.0 (10% compared with 7%, $P=.02$), to be intubated in the delivery room (17% compared with 13%, $P=.001$), or to be diagnosed with hypoxic ischemic encephalopathy (3% compared with 1%, $P<.001$).

CONCLUSION—In emergency cesarean deliveries, neonatal delivery occurred more quickly after a vertical skin incision, but this was not associated with improved neonatal outcomes.

LEVEL OF EVIDENCE—II

Since its initial description in 1897 by Pfannenstiel,¹ a transverse suprapubic incision has been used frequently in both obstetric and gynecologic surgeries. As initially described, the Pfannenstiel incision includes dissection of the rectus muscles from the overlying fascia and ligation of any perforating vessels encountered. In emergency situations, tradition has taught that abdominal entry at the time of cesarean delivery may be facilitated more rapidly through a midline vertical skin incision because rectus dissection is not required and perforating vessels are thus not encountered.² The Pfannenstiel incision is cosmetically more attractive than a vertical incision, is familiar to the obstetric surgeon, and may be associated with less postoperative pain and a lower risk of hernia formation, leading many practitioners to choose this incision location even in emergencies.³

Randomized evaluations of skin incisions for cesarean delivery have been limited to comparisons between the Pfannenstiel and modifications of this transverse skin incision such as the muscle-splitting Maylard incision or the Joel-Cohen incision during which tissue layers are opened bluntly and dissection of the rectus muscles is not required. In these comparisons, the Joel-Cohen entry appears to offer certain advantages, including shorter incision-to-delivery intervals, less blood loss, shorter operating time, reduced time to oral intake, shorter duration of postoperative pain, and a shorter length of stay.^{4,5}

The literature comparing transverse with vertical skin incisions for cesarean delivery is sparse. One study compared 619 cesarean deliveries performed by midline incision with 328 performed by Pfannenstiel skin incision and found no difference in postoperative complications such as wound healing or wound hematoma.⁶ The time required to deliver the neonate was not compared, and both elective and emergency deliveries were included.

The purported shorter incision time with a vertical incision has not been rigorously confirmed. Therefore, the purpose of this analysis was to compare incision-to-delivery intervals, total operative time, and maternal and neonatal outcomes by skin incision (transverse compared with vertical) in a large cohort of women undergoing emergency cesarean delivery at multiple hospitals throughout the United States.

MATERIALS AND METHODS

The cesarean registry, a prospective observational study conducted by 13 institutions in the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network between 1999 and 2002, was designed to assess

several specific contemporary issues.⁷ During the first 2 years of the cohort, information concerning all cesarean births within the Maternal–Fetal Medicine Units Network was ascertained. During the second 2 years, data were collected only for repeat cesareans and attempted vaginal births after prior cesarean. For the current study, only data collected during the first 2 years of the study were analyzed so that there would not be an imbalance in the type of cesarean deliveries. Each participating network center and the data coordinating center received Institutional Review Board approval for this study.

Detailed information regarding maternal demographic characteristics, medical and obstetrical history, intrapartum course, postpartum complications diagnosed before hospital discharge, and neonatal outcome was abstracted directly from maternal and neonatal charts by specially trained and certified research nurses. Longer-term maternal outcomes such as chronic pain, hernia formation, and cosmetic satisfaction were not available from the registry.

This analysis was limited to singleton emergency cesarean deliveries defined as those indicated to be emergent on individual record review that were performed for a diagnosis of umbilical cord prolapse, abruption, placenta previa with hemorrhage, nonreassuring fetal heart rate tracing, or uterine rupture. Stillbirths ($n=27$) were excluded because this could potentially influence the swiftness of delivery. Skin incisions were coded as either transverse or vertical. Skin incision, neonatal delivery, and skin closure times were ascertained from intraoperative records and used to calculate incision-to-delivery and incision-to-closure intervals in minutes.

Baseline variables and maternal delivery characteristics were compared by skin-incision type. Categorical variables were compared using the Pearson's chi-square or the Fisher exact test. Continuous variables were compared by the Wilcoxon rank sum test. Time intervals were analyzed by transverse compared with vertical skin-incision type after stratifying by primary compared with repeat cesarean delivery. Analysis of covariance was conducted after stratifying by primary and repeat cesarean deliveries to compare the mean differences in time intervals between the skin incision groups adjusting for body mass index at delivery.⁸ Analysis was confirmed using rank analysis of covariance because the data violated the normality assumption of the residuals by the Kolmogorov-Smirnov test. In addition, a subgroup analysis of incision-to-delivery intervals by indication for emergent delivery was performed. For maternal outcomes, the cohort was compared by type of skin incision after stratifying by primary compared with repeat cesarean delivery. Neonatal outcomes were compared by type of skin incision. Nominal two-sided probability values are reported with statistical significance defined as $P<.05$. No adjustments were made for multiple comparisons. Statistical analyses were performed using SAS software (SAS Institute, Inc, Cary, NC).

RESULTS

During 1999 and 2000, a total of 184,387 women delivered in Maternal–Fetal Medicine Units Network hospitals and 39,283 (21.3%) of these women underwent cesarean delivery. As shown in Figure 1, 3,525 (9.5%) emergency cesarean deliveries of singleton live births were available for analysis. A transverse incision was performed in 2,498 (70.9%) of these deliveries and vertical skin incisions performed in the remaining 1,027 (29.1%). Vertical incisions were more commonly performed during emergent cesarean deliveries than during nonemergent cesarean deliveries (29.1% compared with 20.4%, $P<.001$). The proportion of women undergoing vertical incisions did not differ by indication for emergent delivery ($P=.34$).

Women delivered by a transverse skin incision had a lower body mass index at delivery and were more likely to be nulliparous and white (Table 1). Women with a transverse skin incision were more likely to be undergoing a primary cesarean delivery compared with those in the vertical group (84% compared with 81%, $P=.01$) (Table 2). There were no other differences in assessed delivery characteristics.

In primary emergency cesarean deliveries, the median incision-to-delivery interval was 1 minute longer in women with a transverse skin incision when compared with those having vertical incisions (median 4, interquartile range 2–7 compared with median 3, interquartile range 2–4, $P<.001$) (Table 3). Among women undergoing repeat emergency cesarean deliveries, the median incision-to-delivery was 2 minutes longer with a transverse incision (median 5, interquartile range 3–9 compared with median 3, interquartile range 2–6, $P<.001$) (Table 3). Even after adjusting for body mass index at delivery using analysis of covariance, both primary and repeat cesarean deliveries had longer mean incision-to-delivery intervals with transverse incisions. For primary cesareans, the adjusted mean difference was 2.0 minutes (95% confidence interval 1.5 to 2.4, $P<.001$). For repeat cesareans, the adjusted mean difference was 1.6 minutes (95% confidence interval 0.6 to 2.6, $P=.002$). Despite longer incision-to-delivery intervals, the median total operative time was shorter by 3 minutes in primary cesarean deliveries and by 4 minutes in repeat cesarean deliveries for surgeries performed through a transverse skin incision (Table 3).

Longer incision-to-delivery intervals by transverse incision occurred both among centers that performed the majority of their emergency cesarean deliveries by transverse skin incision as well as among those primarily performing vertical incisions (data not shown). In subgroup analysis by indication for emergent cesarean delivery, a longer incision-to-delivery interval was again evident for transverse incisions performed for nonreassuring fetal tracings, abruptions, or cord prolapse. The longer intervals did not reach statistical significance in the previa with hemorrhage or uterine rupture subgroup perhaps secondary to a small sample size (Table 4).

Table 5 demonstrates selected maternal outcomes. There were no differences identified in the risk of intraoperative injury (broad ligament hematoma, cystotomy, bowel injury, ureteral injury) or postoperative ileus by type of skin incision. The frequency of wound infections and wound hematomas was similar between the two skin incision groups. Among women with vertical skin incisions, postpartum transfusions were more common both after primary (7% compared with 5%, $P=.01$) and repeat cesarean delivery (14% compared with 8%, $P=.02$). Among primary emergency cesarean deliveries, there was an increased incidence of postpartum endometritis in women delivered by vertical skin incisions (15% compared with 11%, $P=.006$). Length of stay after discharge was similar in both groups.

Despite shorter incision-to-delivery intervals, neonates delivered through a vertical incision were more likely to be intubated in the delivery room, to have an umbilical artery pH less than 7.0, or to be diagnosed with hypoxic ischemic encephalopathy (Table 6). There were no differences in neonatal outcomes by skin-incision type after cord prolapse, the subgroup that was delivered the swiftest (data not shown).

DISCUSSION

This secondary analysis of a large cohort of women undergoing emergency cesarean delivery sought to answer the question of whether the skin incision, transverse compared with vertical, is associated with a difference in the incision-to-delivery time, total operative time, maternal complications, or adverse neonatal outcomes. In this study, transverse skin incision lengthened the median incision-to-delivery interval by 1 minute for primary

cesarean deliveries and by 2 minutes for repeat cesarean deliveries. Our sample size allowed for more than 80% power to detect a 0.25 standard deviation for the incision-to-delivery interval between the vertical and transverse incision groups in both primary and repeat cesarean deliveries.

We recognize that differences in speed of entry after the two incision locations may vary by institution or by individual surgeon. Nonetheless, in our cohort, newborn extraction was swifter after a vertical incision, even in centers that performed the majority of emergency deliveries by transverse incision.

It is difficult to codify the urgency of delivery. Our cohort, despite being limited to emergency cesarean deliveries, likely contains a range of urgency as demonstrated by the finding that neonates were delivered in less than 2 minutes in only 25% of our sample. The subgroup analysis by indication for delivery confirmed longer incision-to-delivery intervals among women delivered through transverse skin incisions in the situation of cord prolapse, considered to be perhaps more uniformly urgent than other indications with a more variable range of urgency.

Although this study validates traditional teaching that abdominal entry is quickest after vertical skin incision, at least in the setting of large teaching institutions, speed for speed's sake alone cannot be advocated without addressing whether the identified time difference is clinically significant in improving neonatal outcome without increasing significant maternal complications. Immediate intraoperative and postoperative maternal complications were similar between the groups with the primary exception of an increase in postpartum transfusions for both primary and repeat cesarean deliveries after vertical skin incisions. The proportion of women undergoing emergent cesarean delivery for hemorrhagic situations (abruption, previa with hemorrhage) did not differ between the transverse and the vertical skin incision groups; nonetheless, there are a number of other variables that could affect the need for postpartum transfusion such as preoperative hemoglobin or intra-operative or postoperative uterine atony that were not assessed in this analysis. The identified differences in transfusion rates could be attributable, at least in part, to uncontrolled confounding factors rather than being a reflection of the skin-incision type. Postpartum endometritis was also more common after vertical skin incisions in primary cesarean deliveries, although it is difficult to hypothesize how the incision location might affect this. Again, this may reflect underlying confounding conditions not controlled for in the analysis linked with both incision and infection.

Despite a statistically significant difference in incision-to-delivery time by skin-incision type, neonatal outcomes were not improved among those delivered through a vertical skin incision. In fact, we found improved neonatal outcomes after delivery through a transverse incision. Our results must be interpreted with caution because our study was limited by its observational nature and the potential for confounding that would not have been present if this had been a randomized clinical trial. Women were not randomized to skin-incision type, and the rationale for why a physician chose a particular skin incision was not captured in the database. In repeat cesarean deliveries, for instance, we do not know the location of the prior skin incision and whether this influenced the current incision type.

Despite data being collected contemporaneously to the delivery, our analysis was unable to quantify the degree of urgency with which an emergency cesarean delivery was performed. Our data may simply demonstrate that the sickest fetuses were delivered the quickest. Although transverse incisions were used more frequently than vertical incisions in both emergent and nonemergent cases, in this cohort, the frequency of vertical incision use was increased among emergent cases. Perhaps vertical incisions were chosen in the most urgent

situations, biasing the results toward an apparent time advantage and an apparent neonatal disadvantage with this approach. Individual surgeon experience was also not assessed and may have impacted incision choice, swiftness of the delivery interval, and outcome.

In a separate publication from this registry analyzing the effects of decision-to-incision intervals on neonatal outcomes in emergency cesarean delivery, adverse neonatal outcomes were not increased in emergency cesarean deliveries performed more than 30 minutes after the decision to operate.⁹ It is therefore not surprising that the additional 1 to 2 minutes saved by performing vertical skin incisions did not translate into improved newborn outcomes given the absence of a measurable negative effect with the much longer time intervals in the decision-to-incision analysis. Nonetheless, in certain emergent situations such as a cord prolapse without a detectable fetal heart rate or a profound prolonged bradycardia, the additional 1 to 2 minutes saved by a vertical skin incision could perhaps be significant.

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Fig. 1.

Flowchart of cohort selection.

Wylie. Skin Incision for Emergency Cesarean Delivery. Obstet Gynecol 2010.

Table 1

Baseline Characteristics Among Women Undergoing Emergency Cesarean Delivery by Skin Incision

Characteristic	Transverse Incision (n=2,498)	Vertical Incision (n=1,027)	P
Age (y)	26.9±6.8	26.5±6.7	.10
Body mass index at delivery (kg/m ²)*	31.5±6.8	32.4±7.6	.02
Race			<.001
White	924 (37)	162 (16)	
African American	1,162 (47)	421 (41)	
Hispanic	278 (11)	406 (40)	
Other	134 (5)	38 (4)	
Preexisting diabetes mellitus	44 (2)	26 (3)	.14
Gestational diabetes	126 (5)	52 (5)	.98
Nulliparous	1,216 (49)	439 (43)	.002

Data are mean±standard deviation or n (%) unless otherwise specified.

* Data on body mass index at delivery were missing for 9% of the patients—162 (6%) patients in the transverse group and 153 (15%) in the vertical group.

Table 2

Delivery Characteristics Among Women Undergoing Emergency Cesarean Delivery by Skin Incision

	Transverse Incision (n=2,498)	Vertical Incision (n=1,027)	P
Gestational age at delivery (wk)	37.2±4.4	37.0±4.8	1.0
Preterm delivery (less than 37 wk)	821 (33)	343 (34)	.71
Birth weight (g)	2,760±948	2,721±985	.33
Number of prior cesarean deliveries			<.001
0	2,107 (84)	830 (81)	
1	341 (14)	150 (15)	
2	45 (2)	33 (3)	
3 or more	4 (0.2)	14 (1)	
Indications for delivery			.34
Nonreassuring fetal tracing	1,996 (80)	816 (79)	
Abruptio	199 (8)	71 (7)	
Placenta previa with hemorrhage	84 (3)	31 (3)	
Cord prolapse	209 (8)	102 (10)	
Uterine rupture	10 (0.4)	7 (0.7)	

* Data are mean±standard deviation or n (%) unless otherwise specified.

Table 3

Incision-to-Delivery and Incision-to-Closure Intervals Among Women Undergoing Primary Emergency Cesarean Deliveries and Repeat Emergency Cesarean Deliveries

	Incision-to-Delivery Interval [†] (min)		Incision-to-Closure Interval [†] (min)	
	Transverse Incision	Vertical Incision	Transverse Incision	Vertical Incision
Primary CD				
Sample size [*]	2,107	830	2,081	826
	5.5±5.2	3.6±5.1	46.7±22.3	50.5±26.1
	4 (2–7)	3 (2–4)	43 (33–55)	46 (37–58)
Repeat CD				
Sample size [*]	391	197	382	197
	6.8±5.8	5.1±5.0	56.4±28.9	67.9±49.8
	5 (3–9)	3 (2–6)	52 (39–63)	56 (45–75)

CD, cesarean delivery.

Data are n, mean±standard deviation, or median (25–75 percentile).

^{*} Sample size for incision-to-closure intervals smaller than the overall cohort secondary to missing information.

[†] All $P<.001$ comparing transverse with vertical incision.

Table 4

Median Incision-to-Delivery Intervals by Indication for Emergency Cesarean Delivery

Indication for Emergent CD*	Median Incision-to-Delivery Interval (min)		<i>P</i> [†]
	Transverse Incision	Vertical Incision	
Nonreassuring fetal tracing	1,996 (71) 4 (2–8)	816 (29) 3 (2–5)	<.001
Abruption	199 (74) 4 (2–6)	71 (26) 3 (2–5)	.006
Placenta previa with hemorrhage	84 (73) 6 (3–10)	31 (27) 4 (2–6)	.06
Cord prolapse	209 (67) 3 (2–5)	102 (33) 2 (2–4)	.04
Uterine rupture	10 (59) 4 (2–7)	7 (41) 2 (1–3)	.22

CD, cesarean delivery.

Data are n (%) or median (25–75 percentile) unless otherwise specified.

* Percentages reflect frequency of skin-incision type within each indication subgroup.

[†] *P*-values from the Wilcoxon rank sum test.

Table 5

Selected Maternal Complications Associated With Emergency Cesarean Delivery According to Skin Incision

Outcome Primary CD	Transverse Incision (n=2,107)	Vertical Incision (n=830)	P
Intraoperative injury*	15 (0.7)	6 (0.7)	.97
Postpartum endometritis	237 (11)	124 (15)	.006
Wound infection	15 (0.7)	9 (1)	.31
Wound hematoma	11 (0.5)	1 (0.1)	.20
Ileus	16 (0.8)	8 (1)	.58
Postpartum transfusion	102 (5)	60 (7)	.01
Length of stay (delivery to discharge)	3.6±2.3	3.8±3.2	.23
Repeat CD	(n=391)	(n=197)	
Intraoperative injury*	15 (4)	5 (3)	.41
Postpartum endometritis	41 (10)	24 (12)	.54
Wound infection	4 (1)	3 (2)	.69
Wound hematoma	4 (1)	2 (1)	1.0
Ileus	5 (1)	3 (2)	1.0
Postpartum transfusion	30 (8)	27 (14)	.02
Length of stay (delivery to discharge)	3.5±1.3	3.9±2.9	.63

CD, cesarean delivery.

Data are mean±standard deviation or n (%) unless otherwise specified.

* Includes broad ligament hematoma, cystotomy, bowel injury, or ureteral injury.

Table 6

Selected Neonatal Outcomes in Relation to Emergency Cesarean Delivery According to Skin Incision

Outcome	Transverse Incision * (n=2,498)	Vertical Incision * (n=1,027)	P
5-min Apgar score 3 or less	88 (4)	50 (5)	.06
Umbilical artery pH less than 7.0 [†]	104 (7)	79 (10)	.02
Intubation in delivery room	316 (13)	172 (17)	.001
Chest compression	83 (3)	38 (4)	.57
Cardiopulmonary resuscitation within 24 h	107 (4)	53 (5)	.26
Hypoxic ischemic encephalopathy	30 (1)	31 (3)	<.001
Neonatal death			
Total	68 (3)	34 (3)	.33
Malformations excluded	47 (2)	22 (2)	.58
None of the above [‡]	2,039 (83)	790 (78)	<.001

* Data are n (%).

[†] Data on umbilical artery pH were missing for 37% of the neonates, 1,059 (42%) in the transverse group and 242 (24%) in the vertical group.

[‡] Includes neonates with 5-minute Apgar scores of 4 or more without intubation in the delivery room, chest compression, cardiopulmonary resuscitation, hypoxic–ischemic encephalopathy, or neonatal death.