

Prolonged second stage of labour, maternal infectious disease, urinary retention and other complications in the early postpartum period

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Objective To study the association between duration of second stage of labour and risks of maternal complications (infection, urinary retention, haematoma or ruptured sutures) in the early postpartum period.

Design Population-based cohort study.

Setting and sample We included 72 593 mothers with singleton vaginal deliveries at ≥ 37 weeks of gestation in cephalic presentation, using the obstetric database from the Stockholm-Gotland region in Sweden, 2008–12.

Methods Logistic regression analysis. Odds ratios (ORs) with 95% confidence intervals (95% CI) were calculated and adjustments were made for maternal age, body mass index, height, smoking, cohabitation, gestational age, labour induction, epidural analgesia and oxytocin augmentation.

Results Rates of any complication varied by parity from 7.3% in parous women with previous caesarean section, 4.8% in primiparas and 1.7% in parous women with no previous caesarean section. Compared with a second stage < 1 hour, the adjusted ORs for any complication (95% CI) in primiparas were

for 1 to < 2 hours 1.28 (1.11–1.47); 2 to < 3 hours 1.54 (1.32–1.79), 3 to < 4 hours 1.63 (1.38–1.93) and ≥ 4 hours 2.08 (1.74–2.49). The corresponding adjusted ORs for parous women without previous caesarean were 2.27 (1.78–2.90), 2.97 (2.09–4.22), 3.65 (2.25–5.94) and 3.16 (1.44–6.94), respectively. The adjusted ORs for women with previous caesarean were for 1 to < 2 hours 1.62 (1.13–2.32); 2 to < 3 hours 1.56 (1.00–2.43), 3 to < 4 hours 2.42 (1.52–3.87), and ≥ 4 hours 2.31 (1.25–4.24).

Conclusions Risks of maternal complications in the postpartum period increase with duration of second stage of labour also after accounting for maternal, pregnancy and delivery characteristics. Special attention has to be given to parous women with previous caesarean deliveries.

Keywords Infectious disease, labour, postpartum, second stage, urinary retention.

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Introduction

Prolonged second stage of labour is usually defined as 2–3 hours for primiparous women and 1–2 hours for parous women, with the longer interval for women with epidural analgesia during labour.^{1,2} Prolonged second stage of labour has been associated with increased risk of maternal morbidity, including postpartum complications like infection or fever.^{3–9} Postpartum urinary retention is a serious complication with both short-term and possible long-term consequences for the mother.¹⁰ The bladder overdistension

can lead to denervation, detrusor atony and prolonged voiding dysfunction.¹¹ The association with duration of second stage of labour has only been investigated in one previous study with a nonsignificant finding.¹²

Because maternal and pregnancy characteristics, such as parity, smoking, induction of labour and epidural analgesia, are associated with both duration of second stage of labour and risk of maternal complications, confounding by such factors may have influenced previous findings.^{7,13,14} Furthermore, many previous studies were limited in size and did not have detailed information from the partograph

on labour progress, epidural analgesia, oxytocin use for labour augmentation and mode of delivery, factors that may influence duration of second stage of labour and possibly risks of postpartum complications.^{13–15}

In this population-based study with detailed medical record information on more than 70 000 vaginal births, we examined the association between duration of second stage of labour and maternal complications during in-hospital care, such as infection, urinary retention, haematoma or ruptured sutures during hospital maternity care.

Methods

Data sources

Data on mother, delivery and infant characteristics were obtained from the population-based Stockholm-Gotland Obstetric Database. This database consists of automatically retrieved information from the medical record system used in the region for all maternity, delivery and postnatal care units. The data are forwarded daily from the medical records to the database and include information from 1 January 2008 and onwards. The database includes all prospectively collected information from antenatal care by attending midwives or physicians and all information from delivery (with partograph data) and the postpartum period for both mother and child in a standardised manner.

Study population

The study population was defined as all vaginal deliveries with a singleton, liveborn infant in cephalic presentation at 37 completed weeks of gestation or later, from 1 January 2008 through to 31 December 2012 ($n = 91\,893$). Deliveries without any partograph data ($n = 4180$) and deliveries without recorded time of retracted cervix ($n = 15\,120$) were excluded.

Exposures and outcomes

Labour partograph data were used to measure the duration of second stage of labour, defined as time in minutes from the first notation of a fully retracted cervix until delivery. Duration of second stage of labour was categorised into five groups: <1 hour (reference); 1 to <2 hours; 2 to <3 hours; 3 to <4 hours; and ≥ 4 hours. Outcomes were diagnosis of maternal complications in the early postpartum period (hospitalisation after delivery) categorised as: (a) infections (including endometritis, urinary tract infection, wound infection and other specified infections); (b) urinary retention (defined as >1000 ml at catheterisation or postvoid residual bladder volume >300 ml); (c) haematoma in birth canal or ruptured perineal sutures; and (d) any of these complications (a, b or c). Maternal complications were obtained from the International Classification of Diseases, 10th revision, diagnosis at discharge from the deliv-

ery hospital according to the Supporting information (Table S1). The Stockholm-Gotland Obstetric Database provided data on maternal age at delivery, maternal height, body mass index, cigarette smoking and cohabitation at first attendance to antenatal care, which generally takes place between weeks 7 and 12 of gestation. Delivery and infant characteristics, such as onset of labour, epidural analgesia, oxytocin for labour augmentation, mode of delivery, episiotomy and birthweight, were obtained from the partograph and standardised delivery records. Gestational age was based on ultrasound examination, which is offered to all women in early second trimester, and most pregnancies are dated by this method. If data on ultrasound were not available, last menstrual period was used for pregnancy dating. Variables were categorised according to Table 1.

Statistical analyses

Crude odds ratios and adjusted odds ratios (aOR) with 95% confidence intervals (95% CI) were calculated by unconditional logistic regression analysis. Logistic regression models were adjusted for maternal age, parity, height, body mass index, smoking, gestational age, induction of labour, epidural analgesia and oxytocin augmentation during delivery. Effect modification was tested by stratification and insertion of an interaction variable in the regression models. Variables with significant interaction results are presented in stratified analyses. A P -value of <0.05 was considered statistically significant. Women with missing data were not included in the analysis.

Results

From 2008 through to 2012 there were 72 593 vaginal births at 37 weeks of gestation or later of singleton infants in cephalic presentation in the Stockholm-Gotland Obstetric Database. Among deliveries with a partograph record for time of retracted cervix the proportion of complications during maternity hospital care was 3.6% ($n = 2629$). Among women who were excluded because of a missing partograph record for time of retracted cervix ($n = 15\,120$), the corresponding proportion was 1.5% ($n = 222$).

Rates of complications increased with time from retracted cervix to birth. The rate of any complication among parous women with previous caesarean section was 7.3%, in primiparous women 4.8%, and in parous women with no previous caesarean section 1.7%. Induced deliveries, epidural analgesia and oxytocin augmentation during labour were associated with increased rates of maternal postpartum complications. Instrumental delivery and advanced gestational age were associated with higher rates of maternal complications in the early postpartum period. Women with postpartum complications were more likely

Table 1. Maternal and delivery characteristics, and rate of any maternal complication in the early postpartum period; women with singleton term or post-term vaginal deliveries in the Stockholm-Gotland region, Sweden, 2008–12

Characteristics	Any complication*		No complication		P-value
	n	%	n	%	
	2629	3.6	69 964	96.4	
Time from retracted cervix to birth (hours)					
<1	841	2.1	39 861	97.9	<0.0001
1 to <2	690	4.5	14 491	95.5	
2 to <3	490	5.9	7851	94.1	
3 to <4	341	6.6	4807	93.4	
≥4	267	8.3	2954	91.7	
Maternal age (years)					
≤24	333	3.9	8162	96.1	0.061
25–29	709	3.7	18 504	96.3	
30–34	993	3.7	26 024	96.3	
≥35	591	3.3	17 225	96.7	
Missing	3	–	49	–	
Parity					
Primiparous	1853	4.8	36 561	95.2	<0.0001
Parous with previous caesarean	240	7.3	3059	92.7	
Parous with no previous caesarean	521	1.7	29 465	98.3	
Missing	15	–	879	–	
Height (cm)					
≤154	92	4.4	2019	95.6	0.19
155–164	869	3.6	23 577	96.4	
165–174	1327	3.6	35 901	96.4	
≥175	310	3.8	7838	96.2	
Missing	31	–	629	–	
Body mass index (kg/m²)					
<20.0	306	3.5	8548	96.5	0.88
20.0–24.9	1436	3.6	38 314	96.4	
25.0–29.9	522	3.6	13 864	96.4	
≥30	196	3.7	5132	96.3	
Missing	169	–	4106	–	
Cohabiting					
Yes	2425	3.6	65 329	96.4	0.020
No	204	4.2	4622	95.8	
Missing	0	–	13	–	
Daily smoking					
Nonsmoker	2544	3.7	66 751	96.3	0.0014
Smoker	85	2.6	3184	97.4	
Missing	0	–	29	–	
Induction of labour					
Yes	552	4.8	10 937	95.2	<0.0001
No	2077	3.4	59 027	96.6	
Epidural analgesia					
Yes	1797	5.0	33 979	95.0	<0.0001
No	832	2.3	35 985	97.7	
Oxytocin during delivery					
Yes	1958	5.0	36 869	95.0	<0.0001
No	671	2.0	33 095	98.0	
Mode of delivery					
Noninstrumental	1898	3.0	61 211	97.0	<0.0001
Instrumental**	731	7.7	8753	92.3	

Table 1. (Continued)

Characteristics	Any complication*		No complication		P-value
	n	%	n	%	
	2629	3.6	69 964	96.4	
Episiotomy					
Yes	151	4.6	3104	95.4	0.0015
No	2470	3.6	66 602	96.4	
Missing	8	–	258	–	
Gestational age (weeks)					
37	93	2.9	3065	97.1	<0.0001
38	268	3.3	7900	96.7	
39	531	3.0	17 174	97.0	
40	868	3.7	22 850	96.3	
41	610	4.0	14 528	96.0	
≥42	259	5.5	4447	94.5	

*Complications include: maternal infectious disease, urinary retention, haematoma or ruptured sutures during postpartum hospital care.

**Vacuum extraction or forceps delivery.

to not live with the baby's father and to be nonsmokers (Table 1).

There was a significant interaction between parity and duration of second stage of labour with respect to risk of maternal complications in the early postpartum period ($P = 0.0002$). Analyses were therefore stratified by parity (primiparous and parous with and without previous caesarean section).

Regardless of time of second stage of labour, parous women with previous caesarean section had generally the highest rates of maternal complications, primiparous women had the second highest, and parous women with no caesarean section had the lowest. In all groups, the risk of any maternal complication generally increased with the duration of second stage of labour. In primiparous women and parous women with previous caesarean section, the risk of any maternal complication for a duration of second stage of labour between 2 and <3 hours was increased by 50% (aOR 1.54, 95% CI 1.32–1.79, and aOR 1.56, 95% CI 1.00–2.43, respectively), whereas corresponding risk increase was three-fold in parous women with no previous caesarean section (aOR 2.97, 95% CI 2.09–4.22). Both rates and adjusted odds ratios for maternal infectious disease and urinary retention increased with duration of labour, whereas this was less evident for haematoma or ruptured sutures in the postpartum period (Table 2).

There was also an interaction between mode of delivery and duration of second stage of labour and risk of maternal complication in the early postpartum period ($P = 0.0048$). Rates of maternal complications were higher in instrumental versus noninstrumental deliveries, and generally increased by duration of second stage in both groups (Table 3). In parous women with previous caesarean

section, the overall rate of any postpartum complication was 6.0% in women with noninstrumental deliveries, and increased with time of second stage of labour from 4.6% to 16.1% (Table 3). In parous women with previous caesarean section and instrumental deliveries, the overall rate of any postpartum complication was 12.2%, but the impact of duration of second stage of labour was less evident (Table 3).

In supplementary analysis we included episiotomy, year of birth and birthweight in the multivariable model. However, none of these variables significantly contributed to the association between duration of second stage of labour and postpartum complication risk.

Discussion

Main findings

We found that risks of maternal early postpartum complications, including infectious disease and urinary retention, increased with duration of second stage of labour: risks were generally lowest if the second stage was <1 hour and highest if second stage was 3 hours or more. Rates of maternal postpartum complications were highest among parous women with previous caesarean section followed by primiparous women, whereas the lowest rates were observed in parous women with no previous caesarean section.

Strengths and limitations

The major strength of the present study was the population-based design with complete access to structured medical record data on the mother, pregnancy, delivery and maternity care. We used information from the partograph,

Table 2. Time from retracted cervix to vaginal delivery and risks of maternal complications during the early postpartum period; analyses are stratified by parity and by previous mode of delivery in parous women

Time from retracted cervix to birth (hours)	Primiparous (n = 38 418)				Parous, previous caesarean (n = 3299)				Parous, no previous caesarean (n = 29 987)			
	n	%	aOR*	95% CI	n	%	aOR*	95% CI	n	%	aOR*	95% CI
Any maternal complication												
<1	412	3.2	1.00	Reference	82	5.1	1.00	Reference	338	1.3	1.00	Reference
1 to <2	506	4.5	1.28	1.11–1.47	71	8.6	1.62	1.13–2.32	109	3.5	2.27	1.78–2.90
2 to <3	408	5.9	1.54	1.32–1.79	35	7.7	1.56	1.00–2.43	45	4.8	2.97	2.09–4.22
3 to <4	285	6.3	1.63	1.38–1.93	34	12.0	2.42	1.52–3.87	22	6.3	3.65	2.25–5.94
≥4	242	8.2	2.08	1.74–2.49	18	12.8	2.31	1.25–4.24	7	5.3	3.16	1.44–6.94
Maternal infection												
<1	211	1.7	1.00	Reference	29	1.8	1.00	Reference	181	0.7	1.00	Reference
1 to <2	216	1.9	1.08	0.88–1.32	31	3.8	2.53	1.43–4.46	46	1.5	2.15	1.51–3.05
2 to <3	170	2.5	1.24	1.00–1.55	13	2.9	1.87	0.91–3.86	15	1.6	2.24	1.28–3.92
3 to <4	101	2.2	1.12	0.86–1.45	11	3.9	2.53	1.15–5.57	7	2.0	2.74	1.24–6.05
≥4	92	3.1	1.54	1.18–2.01	9	6.4	3.85	1.58–9.38	2	1.5	1.93	0.47–8.01
Urinary retention												
<1	123	1.0	1.00	Reference	38	2.4	1.00	Reference	103	0.4	1.00	Reference
1 to <2	206	1.8	1.67	1.32–2.12	30	3.6	1.09	0.65–1.85	47	1.5	2.52	1.71–3.72
2 to <3	187	2.7	2.26	1.77–2.90	21	4.6	1.55	0.87–2.78	29	3.1	4.51	2.80–7.26
3 to <4	167	3.7	3.06	2.37–3.96	19	6.7	2.14	1.15–3.98	13	3.7	5.09	2.67–9.69
≥4	141	4.8	3.79	2.89–4.96	11	7.8	2.30	1.06–5.00	3	2.3	3.14	0.96–10.27
Haematoma or ruptured sutures												
<1	101	0.8	1.00	Reference	23	1.4	1.00	Reference	61	0.2	1.00	Reference
1 to <2	111	1.0	1.17	0.88–1.55	19	2.3	1.66	0.84–3.25	18	0.6	1.99	1.07–3.70
2 to <3	74	1.1	1.19	0.86–1.65	7	1.5	1.37	0.55–3.46	4	0.4	1.90	0.66–5.52
3 to <4	33	0.7	0.79	0.52–1.21	5	1.8	1.56	0.53–4.53	3	0.9	2.50	0.58–10.77
≥4	26	0.9	1.01	0.64–1.59	1	0.7	0.62	0.08–4.93	2	1.5	6.51	1.48–28.61

*Adjusted for maternal age, height, body mass index, parental cohabitation, smoking, induction of labour, gestational age epidural analgesia and oxytocin augmentation.

Table 3. Time from retracted cervix to vaginal birth and risk of any maternal complication during the early postpartum period stratified by mode of delivery

Time from retracted cervix to birth (hours)	Primiparous				Parous, previous caesarean				Parous, no previous caesarean			
	n	%	aOR*	95% CI	n	%	aOR*	95% CI	n	%	aOR*	95% CI
Any maternal complication in noninstrumental vaginal deliveries												
Primiparous (n = 30 649)												
<1	348	3.0	1.00	Reference	67	4.6	1.00	Reference	322	1.3	1.00	Reference
1 to <2	393	4.1	1.27	1.09–1.48	45	7.0	1.47	0.96–2.25	89	3.2	2.19	1.69–2.84
2 to <3	283	5.4	1.56	1.31–1.85	19	6.0	1.32	0.75–2.31	34	4.3	2.80	1.89–4.15
3 to <4	151	5.3	1.54	1.24–1.89	18	10.8	2.33	1.28–4.25	11	4.5	2.74	1.42–5.30
≥4	91	6.5	1.80	1.40–2.33	10	16.1	3.48	1.56–7.76	3	4.2	2.60	0.80–8.42
Any maternal complication in instrumental vaginal deliveries												
Primiparous (n = 7769)												
<1	64	5.2	1.00	Reference	15	10.2	1.00	Reference	16	3.5	1.00	Reference
1 to <2	113	6.9	1.22	0.88–1.70	26	14.3	1.84	0.88–3.88	20	7.8	1.71	0.79–3.71
2 to <3	125	7.6	1.27	0.92–1.76	16	11.6	1.60	0.70–3.65	11	7.5	2.21	0.91–5.39
3 to <4	134	7.9	1.38	1.00–1.91	16	13.7	2.01	0.86–4.69	11	10.2	3.30	1.30–8.37
≥4	151	9.7	1.71	1.24–2.35	8	10.1	1.06	0.38–2.95	4	6.6	2.03	0.60–6.90

*Adjusted for maternal age, height, body mass index, parental cohabitation, smoking, induction of labour, gestational age epidural analgesia and oxytocin augmentation.

including prospectively collected data on labour progress and interventions during delivery. Hence we were able to investigate duration of the second stage of labour and the influence on epidural analgesia, oxytocin for labour induction, mode of delivery as well as information on complications during in-hospital maternity care. Because data on exposure were recorded before outcome there was no possibility for recall bias. We also tested for effect modification between maternal and delivery characteristics associated with prolonged second stage of labour and risk of any maternal complication. We found significant interactions for parity including vaginal birth after caesarean as well as for mode of delivery (instrumental or noninstrumental).

Although we used information on more than 70 000 singleton births, the number of adverse maternal outcomes for women with prolonged duration of second stage of labour was limited in some groups, which is reflected by the relatively wide confidence intervals. This may also explain why there was not always a linear association between duration of second stage of labour and complication risk. A proportion of women from the study base (17%) did not have data on time from retracted cervix until delivery because there was no recording of vaginal examinations during this period of labour. These women were less likely to have maternal complications, suggesting that their second stage of labour was shorter. Follow up from delivery was restricted to the hospitalisation period and we were not able to study complications after discharge from the delivery hospital. Although the validity of included diagnoses may be a concern, we find it unlikely that the validity should differ by duration of second stage of labour. Hence, any possible misclassification is likely to be nondifferential between exposure groups, and we may consequently have underestimated possible risks.

Interpretation

The association between prolonged second stage of labour and risk of maternal infection is in agreement with previous studies on prolonged second stage and risk of chorioamnionitis among primiparous and multiparous women.^{4,6} Similar findings were also reported in a large cohort study by Allen et al.⁷ However, due to a large amount of missing data, maternal characteristics were not included in multivariate models whereas this was possible in the present study. In a recent study by Laughon et al.,³ elevated risks for maternal complications including chorioamnionitis were reported; however this study compared prolonged versus within-time limits for second stage of labour according to the US guidelines.¹

As pointed out by Altman et al.¹³ in a systematic review of prolonged second stage of labour, it is important to address method of delivery as an effect modifier, which is

in line with findings from our study. Although we found that the highest absolute risks of postpartum complications were found among parous women with previous caesarean section, we also found that time of second stage was of greater relative importance in parous women with no previous caesarean section.

For the first time we report an association between prolonged second stage of labour and postpartum urinary retention. In the present study, urinary retention rates increased with duration of second stage of labour among primiparous and parous women, with the highest rates among women with a previous caesarean section. No significant differences in postpartum urinary retention were reported in a Taiwanese study based on only 165 women with prolonged second stage of labour and 1750 control births.¹² An Indian investigation found that women with urinary retention had a longer duration of labour (379 versus 306 minutes) without differentiation between first and second stage.¹⁶ Finally Yip et al.¹⁷ reported that prolonged first and second stage of labour was positively associated with increased post-void residual bladder volume. According to a recent review by Mulder et al.,¹⁰ postpartum urinary retention is not to be regarded as without danger of long-term adverse effects and clinicians should identify women with increased risk.

Because prolonged second stage of labour increases the risk of infectious disease, especially among women who are nulliparous or with a previous caesarean section, special attention must be paid to infectious symptoms in maternity care. Causes for both urinary tract infection and urinary retention may include frequent bladder catheterisation, vaginal examinations, instrumental delivery, all of which are likely to increase with epidural analgesia.¹⁸ Furthermore, epidural analgesia and oxytocin augmentation were important interventions associated with both prolonged second stage of labour and complications in the postpartum period. Our findings suggest that close supervision of the urinary bladder is important during the second stage of labour, especially among women with epidural analgesia. The long-term consequences of urinary retention during delivery are not fully known.¹⁰

It is generally known that primiparous women have increased rates of adverse pregnancy outcomes. Our findings that the highest absolute and relative risks of infectious disease were found in parous women with previous caesarean section warrant further investigation. These deliveries are generally under greater supervision because of risk of uterine rupture¹⁹ but we cannot explain why a previous caesarean would lead to higher complication rates. One may speculate that more careful use of oxytocin augmentation may increase duration of second stage of labour; however, this was accounted for in the analysis. On the other hand, it is important to point out that the

recommendation should not be against vaginal birth after caesarean because the absolute risks are still low.

Swedish delivery guidelines²⁰ are in accordance with the US guidelines¹ and the UK guidelines by the National Institute for Health and Care Excellence,² stating that birth would be expected to take place within 3 hours of the start of the active second stage in most nulliparous women, and 2 hours for multiparous women. Hence, the findings from the present study could be generalised to other developed countries. There has been criticism for the over-medicalisation of childbirth and this has implications for the clinical management of second stage of labour.¹³ Because prolonged second stage of labour is associated with maternal complications, this could be managed by more interventions with instrumental deliveries as well as oxytocin augmentation. However, these interventions *per se* have higher rates of maternal complications and can therefore not be a safe alternative. Furthermore, performing caesarean section at full dilatation additionally increases rates of maternal complications²¹ and risk of a repeat caesarean in a subsequent pregnancy.

Conclusion

Prolonged second stage of labour, more than 2 hours, is associated with maternal infectious disease and urinary retention in maternity care. A better control of voiding during and after delivery and check-up for signs of maternal infection are warranted for these women. Future research should study long-term consequences in women with urinary retention during labour. Special attention has to be given to parous women with previous caesarean section.

Disclosure of Interests

None to declare for the contributing authors.

Contribution to authorship

OS conceived and designed the study together with SC and AKW. OS and GP performed the analyses. GP, AS and OS contributed with materials. OS, KM, AS, AKW and SC wrote the paper.

Details of ethics approval

The regional ethical committee at Karolinska Institutet, Stockholm, Sweden approved the study protocol (No. 2009/275-31 and No. 2012/365-32).

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. ICD-10 codes for Maternal Complications. ■

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