International Urogynecology Journal (2020) 31:529–533
https://doi.org/10.1007/s00192-019-04010-y

ORIGINAL ARTICLE

Risk factors for overt postpartum urinary retention—the effect of the number of catheterizations during labor

Maia Rosenberg[1] · Ariel Many[2] · Shiri Shinar[3]

Received: 18 April 2019 / Accepted: 30 May 2019 / Published online: 20 June 2019

Abstract

Introduction and hypothesis Our aim was to examine the effect of the number of catheterizations during labor on the development of overt postpartum urinary retention (PUR) in women who had a vaginal delivery with epidural anesthesia.

Methods A single-center retrospective matched case–control study between 1 January 2015 and 31 December 2016. Women who developed overt PUR were compared with those who did not following a singleton vaginal delivery with epidural anesthesia. For each study two controls, matched for maternal age, gestational age at delivery, and parity, were selected. Each woman's controls were the immediate subsequent or previous delivery that met matching criteria.

Results Two hundred parturients with overt PUR were matched with 400 parturients without overt PUR. In univariate analysis, women with PUR underwent significantly more catheterizations during labor, had an epidural for a longer period of time, and were more likely to have undergone a vacuum-assisted delivery and a mediolateral episiotomy ($p < 0.01$ for all). In multivariate analysis controlling for epidural duration, episiotomy, and vacuum-assisted delivery, the risk of PUR among women with at least two catheterizations was greater when fewer catheterizations were performed (OR = 0.78, 95% CI 0.61–0.99). When controlling for the number of catheterizations overall, episiotomy, and vacuum-assisted delivery, PUR risk significantly increased with a longer epidural duration (OR 1.23, 95% CI 1.17–1.29). Episiotomy and vacuum-assisted delivery had no significant effect on PUR.

Conclusions The risk of PUR decreases as the number of catheterizations increases. Although longer epidural duration independently increases the risk of PUR, episiotomy and vacuum-assisted delivery do not.

Keywords PUR · Postpartum urinary retention · Risk factor · Epidural · Catheterization

Introduction

Postpartum urinary retention (PUR) is a common complication, occurring in 1.5% to 45% of parturients [1]. It is associated with short- and long-term morbidity, such as increased risk for upper and lower urinary tract infections and irreversible detrusor damage with prolonged voiding dysfunction, in cases left undiagnosed and untreated [2].

Previous studies have shown that acute PUR is associated with epidural anesthesia [3]. The effect of epidural appears to be mediated through other risk factors of labor and delivery, including nulliparity [4–6], instrumental delivery [5–7], vaginal or perineal trauma, and a prolonged second stage of labor [8–10]. With increasing prevalence of epidural anesthesia and instrumental deliveries [9], PUR is becoming a more pertinent and widespread complication.

At present, there are no recommended guidelines for intrapartum bladder management for women with an epidural catheter. Subsequently, there has been a wide variation in bladder care, both intrapartum and postpartum, across maternity units worldwide [2]. In an attempt to better understand risk factors for overt PUR among parturients who undergo intermittent catheterization, we aimed to examine the effect of the number of catheterizations during labor and volume emptied with each catheterization on the development of overt PUR in women who had a vaginal delivery with epidural

✉ Shiri Shinar
shiri.shinar@sinaihealthsystem.ca; Shirishinar1@gmail.com

[1] Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel

[2] Department of Obstetrics and Gynecology, Lis Maternity Hospital, Sourasky Medical Center, Tel Aviv, Israel

[3] Department of Obstetrics and Gynecology, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada

anesthesia. This knowledge can assist in setting the basis for intrapartum bladder care guidelines aimed at decreasing PUR.

Materials and methods

In this single-center retrospective matched case–control study, we compared women who developed overt PUR (cases) with those who did not develop PUR (controls) following a singleton vaginal delivery with epidural anesthesia.

Our institutional guidelines dictate intermittent catheterization for intrapartum bladder management in laboring women with an epidural. Catheterizations are performed every 2 to 4 h by the attending midwife, with the volume of urine emptied duly recorded. Bladder catheterization is routinely performed prior to operative vaginal deliveries and before transfer of the parturient to the postpartum ward. Immediately after delivery of the placenta, the epidural anesthetic is discontinued, with the epidural catheter removed before transfer to the postpartum ward.

We reviewed all singleton vaginal births that occurred in our tertiary center between 1 January 2015 and 31 December 2016. Overt PUR was defined as the need for at least one catheterization within the first 24 h postpartum, as recorded in the patient's health record, for one or more of the following reasons: the patient had not voided within 6 h postpartum; the patient voided frequently in small amounts; the patient had an urge to void, but could not void [7, 11]. Parturients with overt PUR were extracted for further analysis. Women with a history of urinary tract complications or pre-existing medical conditions associated with potential urinary retention (such as multiple sclerosis or long-standing diabetes mellitus) were excluded, as were women with a recent diagnosis of a urinary tract infection (UTI) up to 4 weeks prior to delivery or under antibiotic treatment for a UTI at the time of delivery. Additionally, women with combined spinal–epidural anesthesia or accidental spinal anesthesia were excluded. For each study case two control cases, matched for maternal age at delivery (±3 years), gestational week at delivery (±2 weeks) and parity, were selected. Each woman's controls were the immediate subsequent or previous delivery that met these matching criteria.

Computerized medical records, in which delivery and postpartum data were recorded in real time, were reviewed and data of interest were extracted. This included maternal demographics, medical and obstetrical history, and information regarding the index gestation and delivery. Additionally, the number of catheterizations performed in the delivery room after epidural catheter placement, the volume of urine emptied with each catheterization, the maximum volume emptied, and the length of time from epidural to delivery were recorded.

The study was approved by our local institutional review board (IRB number TLV-0713-16).

A data comparison was made between the study group and control group. A univariate analysis was performed using a Student's *t* test and a Fisher's exact test for continuous variables and for categorical variables, respectively. Logistic regression analysis was performed to identify parameters independently associated with PUR. Odds ratios for independent risk factors were calculated. Two-tailed tests were used in all cases. Probability values of <0.05 were considered significant. Statistical analysis was performed with STATA 15.1 (StataCorp).

Results

During the 2-year study period, there were 18,487 singleton vaginal deliveries in our center. Of these 200 parturients with overt PUR were recognized, for an incidence of 1.1%. These cases were matched with 400 parturients without overt PUR, for a ratio of 1:2, respectively.

Demographic and obstetric characteristics of the study and control groups were comparable by design. Additionally, there were no differences in pre-gestational BMI and in the prevalence of smokers in both groups (Table 1).

In univariate analysis, compared with women without PUR, women with PUR underwent significantly more catheterizations during labor (3 [1.3] vs 3.6 [1.5] respectively, $p < 0.01$), had an epidural for a longer period of time (6.2 [3.9] vs 13.1 [7.8] respectively, $p < 0.01$), and were more likely to have undergone a vacuum-assisted delivery (75 [19] vs 62 [31] respectively, $p < 0.01$) and a mediolateral episiotomy (144 [36] vs 107 [54] respectively, $p < 0.01$; Table 2).

Of our cohort, 117 women (39 in the study group and 78 in the control group; 28.6%) either underwent one catheterization only during labor or were matched to such a parturient. The labor characteristics in these women differed substantially from those of the remaining cohort, who had had at least two catheterizations during labor. As such, they had significantly shorter epidural durations (6.2 [6.2] vs 9.1 [6.4], $p < 0.01$) and a lower incidence of vacuum-assisted delivery (15 [13%] vs 122 [25%]; $p < 0.01$) and episiotomies (39 [34%] vs 212 [44%], $p = 0.04$). Since these cases may be ill suited for examining the relationship between the number of catheterizations and PUR, we performed a sub-analysis for women who underwent at least two catheterizations during labor. Univariate analysis in this subgroup demonstrated that more catheterizations increased the risk of PUR (Table 3). The mean and maximum urine volume emptied was not associated with PUR, nor were perineal tears or their degree (Table 3).

In a logistic regression analysis controlling for epidural duration, episiotomy, and vacuum-assisted delivery, the risk of PUR among women with at least two catheterizations was

Table 1 Maternal baseline characteristics

Characteristic	PUR ($n = 200$)	No PUR ($n = 399$)	p value
Age (years)	31.4 (4.5)	31.5 (4.1)	0.75
Pre-gestational BMI (kg/m^2)	22.8 (4.2)	22.5 (3.6)	0.37
Smoker	4 (2)	17 (4)	0.24
Parity			1.0
One	151 (75)	301 (75)	
Two	33 (17)	66 (17)	
Three	15 (8)	30 (8)	
Four or more	1 (1)	2 (1)	
Gestational age at delivery (weeks)	39.5 (1.3)	39.4 (1.1)	0.73

Data are presented as mean (SD) or n (%)

PUR postpartum urinary retention, *BMI* body mass index

greater when fewer catheterizations were performed (OR = 0.78, 95% CI 0.61–0.99). When controlling for the number of catheterizations overall, episiotomy, and vacuum-assisted delivery, the risk of PUR significantly increased with a longer epidural duration (OR 1.23, 95% CI 1.17–1.29). Episiotomy and vacuum assisted delivery had no independent effect on the risk of PUR (Table 4).

Discussion

The results of this study show that among women with at least two catheterizations during labor, the risk of PUR decreases as the number of catheterizations during labor increases. Although longer epidural duration independently increases the risk of PUR, episiotomy and vacuum-assisted delivery do not.

There are several possible explanations for the association between catheterization frequency and PUR. Infrequent catheterizations can lead to bladder overdistention, resulting in detrusor underactivity and voiding dysfunction [12]. Second, bladder overdistention may lead to bladder nerve damage [13] and inhibition of micturition reflexes [6]. More frequent catheterizations prevent bladder overdistention and can thus decrease the risk of PUR. A recent study by Polat et al. found that the number of peripartum micturations was significantly higher in women without PUR, and an increase in one void reduced the risk for PUR by 24.1%. Moreover, the absence of peripartum bladder catheterization was associated with a 2.2-fold increase in PUR development [14]. Surprisingly, despite the protective role of frequent bladder catheterizations found in our study, a previous randomized controlled study failed to show a benefit to continuous versus intermittent bladder catheterization [15] in preventing PUR. However, in that study, the comparison groups differed in their baseline and labor characteristics. As such, the second stage of labor and the dose of anesthesia were significantly longer in the continuous catheterization group, findings that may have increased the risk for PUR.

Previous studies have shown that regional analgesia is an independent risk factor for clinically overt PUR [1, 6, 7]. Possible explanations include temporary disruption of afferent

Table 2 Risk factors for postpartum urinary retention—univariate analysis

Risk factor	PUR ($n = 200$)	No PUR ($n = 399$)	p value
Number of catheterizations	3.6 (1.5)	3.0 (1.3)	<0.01
Length of epidural (h)	13.1 (7.8)	6.2 (3.9)	<0.01
Average urine volume emptied (ml)	376 (177)	398 (175)	0.15
Maximum urine volume emptied (ml)	570 (281)	576 (257)	0.79
Vacuum-assisted delivery	62 (31)	75 (19)	<0.01
Perineal tears			0.40
No tears	95 (48)	211 (53)	
1st degree	62 (31)	115 (29)	
2nd degree	41 (20)	70 (17)	
3rd or 4th degree	2 (1)	3 (1)	
Episiotomy	107 (54)	144 (36)	<0.01

Data are presented as mean (SD) or n (%)

Table 3 Risk factors for postpartum urinary retention in women with at least two bladder catheterizations during labor—univariate analysis

Risk factor	PUR ($n = 161$)	No PUR ($n = 322$)	p value
Number of catheterizations	3.6 (1.3)	3.3 (1.1)	<0.01
Length of epidural (h)	13.6 (7.8)	6.8 (3.8)	<0.01
Average urine volume emptied (ml)	388 (177)	392 (166)	0.80
Maximal urine volume emptied (ml)	591 (281)	588 (252)	0.89
Vacuum-assisted delivery	52 (32)	70 (22)	0.01
Perineal tears			0.83
No tears	77 (48)	164 (51)	
1st degree	50 (31)	93 (29)	
2nd degree	33 (20)	62 (19)	
3rd and 4th degree	1 (1)	3 (1)	
Episiotomy	86 (53)	126 (39)	<0.01

Data are presented as mean (SD) or n (%)

input, and a prolonged second stage. A longer duration of the second stage of labor exerts prolonged pressure on the pelvic floor, which causes damage to pelvic tissue and nerve plexuses, and leads to outflow obstruction and to detrusor neuropraxia [7, 16]. A longer second stage in nulliparous women may explain why PUR is more common in these women [16]. Protracted PUR (defined by the authors as lasting longer than 72 h) was also affected by a longer second stage of labor than in controls [17]. Previous studies [1, 6, 11, 13, 15, 18] have regarded epidural as a binary risk factor and did not examine the effect of its duration on the risk for PUR. In contrast, our study is noteworthy in that it examined the association between PUR and epidural duration. It is plausible that longer epidural analgesia is associated with longer duration of nerve compression and subsequent nerve damage, resulting in PUR.

Vacuum-assisted delivery and episiotomy were not independent risk factors for PUR in the present study, but likely increased the risk through other factors, such as epidural anesthesia and prolonged labor. There is a lack of agreement in the literature regarding the independent contribution of episiotomy and instrumental delivery to PUR. Some studies have found them to be directly related to PUR [3, 19], whereas others have found them to be indirectly related [6]. We hypothesize that the association between instrumental delivery and episiotomy (commonly performed during vacuum-assisted delivery) and PUR is mediated by a longer duration of labor and longer epidural duration, both of which increase the risk for an assisted vaginal delivery. Indeed, Musselwhite et al., in their retrospective cohort, showed that duration of labor was the strongest single risk factor for the development of PUR [3].

We did not find any association between PUR and the volume of urine emptied or the maximal volume emptied. It is possible that beyond a certain volume of urine, the risk for PUR is mainly driven by the amount of time during which increased pressure was exerted on the detrusor, and not the actual volume of urine retained. This finding is supported by the results of a previous study, which examined the treatment of overt PUR, and did not find a significant effect of the initial volume retained on the duration of treatment necessary [20].

At present, there are no uniform recommendations for the optimal time intervals between catheterizations during labor and institutional guidelines differ from center to center [2]. The strength of this study is in providing support to the importance of more frequent bladder emptying during labor in preventing PUR. Moreover, the finding that longer epidural duration independently increases the risk of PUR, highlights the need for more protocolized bladder treatment during labor, particularly in this higher risk population with regional anesthesia and longer labors. Our case control study design with its matching for confounders for PUR, such as parity [1], is an additional strength. Lastly, in this study, women were included only if they had overt PUR. Covert PUR is a different entity with other risk factors [1], and thus utilizing a homogeneous definition for PUR allows for a more focused study of risk factors pertaining to this population. The main limitation of our study is that it does not address other possible confounders, which may be associated with PUR, such as intrapartum fever, postpartum hemorrhage, blood product transfusions, neonatal birth weight and fetal presentation [1, 4, 6]. Secondly, we could not reliably calculate bladder catheterization frequency during labor, as there was significant variability in time intervals between catheterizations. As such,

Table 4 Risk factors for postpartum urinary retention among women with at least two catheterizations during labor—multivariate analysis

Risk factor	Odds ratios	p value (95% CI)
Number of catheterizations	0.78	0.04 (0.61–0.99)
Length of epidural (h)	1.23	<0.01 (1.17–1.29)
Episiotomy	1.32	0.31 (0.77–2.25)
Vacuum-assisted delivery	1.19	0.57 (0.65–2.21)

some catheterizations were performed routinely, regardless of the time elapsed from the previous catheterization, such as those done prior to assisted vaginal delivery and those done prior to transfer of the parturient to the postpartum unit. Thirdly, it is plausible that the length of epidural was directly related to the duration of labor, and that the latter independently affected the risk of PUR. Nonetheless, as opposed to epidural duration, first- and second-stage durations are difficult to accurately establish, as they are considered a retrospective diagnosis and are affected by the timing of the cervical examination. Lastly, we could not account for postpartum UTIs as a potential etiology for PUR, as urine cultures were not routinely obtained as part of the PUR workup.

In summary, our findings are novel as they suggest that frequent bladder catheterizations during labor might be protective against overt PUR, particularly in women with long labors with epidural anesthesia. Frequent bladder emptying should be key in future guidelines for intrapartum bladder management in women with intermittent catheterizations. Additional studies are required to establish the recommended intervals of bladder catheterization during labor that are least likely to result in overt PUR. Moreover, the potential benefit of continuous vs intermittent bladder catheterization in preventing PUR is worth further investigation.

Compliance with ethical standards

Conflicts of interest None.

References

1. Mulder FEM, Schoffelmeer MA, Hakvoort RA, Limpens J, Mol BWJ, Van Der Post JAM, et al. Risk factors for postpartum urinary retention: a systematic review and meta-analysis. BJOG. 2012;119(12):1440–6.
2. Zaki MM, Pandit M, Jackson S. National survey for intrapartum and postpartum bladder care: assessing the need for guidelines. BJOG. 2004;111(8):874–6.
3. Musselwhite KL, Faris P, Moore K, Berci D, King KM. Use of epidural anesthesia and the risk of acute postpartum urinary retention. Am J Obstet Gynecol. 2007;196(5):472.e1–5..
4. Ching-Chung L, Shuenn-Dhy C, Ling-Hong T, Ching-Chang H, Chao-Lun C, Po-Jen C. Postpartum urinary retention: assessment of contributing factors and long-term clinical impact. Aust N Z J Obstet Gynaecol. 2002;42(4):365–8.
5. Andolf E, Iosif CS, Jorgensen C, Rydhstrom H. Insidious urinary retention after vaginal delivery: prevalence and symptoms at follow-up in a population-based study. Gynecol Obstet Investig. 1994;38(1):51–3.
6. Carley ME, Carley JM, Vasdev G, Lesnick TG, Webb MJ, Ramin KD, et al. Factors that are associated with clinically overt postpartum urinary retention after vaginal delivery. Am J Obstet Gynecol. 2002;187(2):430–3.
7. Yip SK, Brieger G, Hin LY, Chung T. Urinary retention in the postpartum period. The relationship between obstetric factors and the post-partum post-void residual bladder volume. Acta Obstet Gynecol Scand. 1997;76(7):667–72.
8. Katz J, Aidinis SJ. Complications of spinal and epidural anesthesia. J Bone Joint Surg Am. 1980;62(7):1219–22.
9. Ramsay IN, Torbet TE. Incidence of abnormal voiding parameters in the immediate postpartum period. Neurourol Urodyn. 1993;12(2):179–83.
10. Yip SK, Hin LY, Chung TK. Effect of the duration of labor on postpartum postvoid residual bladder volume. Gynecol Obstet Investig. 1998;45(3):177–80.
11. Calgary Health Region. Bladder care/fluid balance: intrapartum and postpartum. Women's and Infant Health Policies and Procedures manual. 2001.
12. Groutz A, Levin I, Gold R, Pauzner D, Lessing JB, Gordon D. Protracted postpartum urinary retention: the importance of early diagnosis and timely intervention. Neurourol Urodyn. 2011;30(1):83–6.
13. Madersbacher H, Cardozo L, Chapple C, Abrams P, Toozs-Hobson P, Young JS, et al. What are the causes and consequences of bladder overdistension? ICI-RS 2011. Neurourol Urodyn. 2012;31(3):317–21.
14. Polat M, Senturk MB, Pulatoglu C, Dogan O, Kilicci C, Budak MS. Postpartum urinary retention: evaluation of risk factors. Turkish J Obstet Gynecol. 2018;15(2):70–4.
15. Evron S, Dimitrochenko V, Khazin V, Sherman A, Sadan O, Boaz M, et al. The effect of intermittent versus continuous bladder catheterization on labor duration and postpartum urinary retention and infection: a randomized trial. J Clin Anesth. 2008;20(8):567–72..
16. Anim-Somuah M, Smyth RM, Jones L. Epidural versus non-epidural or no analgesia in labour. Cochrane Database Syst Rev. 2011;5:CD000331.
17. Mevorach Zussman N, Gonen N, Kovo M, Miremberg H, Bar J, Condrea A, et al. Protracted postpartum urinary retention—a long-term problem or a transient condition? Int Urogynecol J. 2019. https://doi.org/10.1007/s00192-019-03903-2.
18. Mulder FEM, Rengerink KO, van der Post JAM, Hakvoort RA, Roovers JPWR. Delivery-related risk factors for covert postpartum urinary retention after vaginal delivery. Int Urogynecol J. 2016;27(1):55–60.
19. Mulder FEM, Hakvoort RA, de Bruin JP, van der Post JAM, Roovers J-PWR. Comparison of clean intermittent and transurethral indwelling catheterization for the treatment of overt urinary retention after vaginal delivery: a multicentre randomized controlled clinical trial. Int Urogynecol J. 2018;29(9):1281–7.
20. Teo R, Punter J, Abrams K, Mayne C, Tincello D. Clinically overt postpartum urinary retention after vaginal delivery: a retrospective case-control study. Int Urogynecol J Pelvic Floor Dysfunct. 2007;18(5):521–4.