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1 Identification of risk factors for postpartum urinary retention following vaginal deliveries: a  
2 retrospective case-control study

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46 **Abstract**

47 **Objective.** Postpartum urinary retention (PUR) is an uncommon complication of vaginal  
48 delivery, defined as a failure to void spontaneously in the six hours following vaginal birth. The  
49 objective of this study was to identify risk factors for PUR in order to provide prompt  
50 management.

51 **Study Design.** A retrospective, comparative, case-control study, including two groups of 96  
52 patients who delivered vaginally, was conducted at the Women and Children's University  
53 Hospital in Lyon, France. Patients were selected based on data extraction from the medical  
54 records of the obstetrics and gynecology department. The first group included patients with  
55 postpartum urinary retention and the second group, without PUR, was selected randomly,  
56 respecting 1:1 matching criteria, paired according to the year of delivery and patient's age at  
57 delivery.

58 **Results.** Logistic regression analysis found that instrumental delivery (OR 13.42, 95%CI  
59 [3.34;53.86],  $p=0.0002$ ), absence of spontaneous voiding before leaving the delivery room (OR  
60 6.14, 95%CI [2.56;14.73],  $p<0.0001$ ), no intact perineum (OR 3.29, 95%CI [1.10;9.90],  $p=0.03$ )  
61 and vulvar edema or perineal hematoma (OR 8.05, 95%CI [1.59;40.67],  $p=0.01$ ) were  
62 independent risk factors associated with PUR.

63 **Conclusion.** The present study identified risk factors for PUR that should be taken into  
64 consideration as soon as delivery is over in order to implement appropriate management. Future  
65 studies are needed to assess the contribution of early systematic bladder scanning in patients with  
66 risk factors for early diagnosis of PUR.

67 **Keywords:** vaginal delivery; postpartum urinary retention; risk factors; bladder dysfunction

## 68 **Introduction**

69 Postpartum urinary retention (PUR) is an uncommon complication of vaginal delivery. It is  
70 defined as the inability to completely void after giving birth and occurs with an incidence of  
71 0.45% to 0.9% [1]. Yip et al. were the first to make a distinction between overt (symptomatic)  
72 and covert (asymptomatic) PUR [2]. They defined overt PUR as failure to spontaneously void  
73 within six hours of vaginal delivery or catheter removal post-cesarean section [3,4]. Overt PUR  
74 occurs with an incidence of 4.9% [3]. Covert PUR is defined as a post void residual bladder  
75 volume (PVRBV) superior to 150 ml, with no symptoms of urinary retention, and presents with  
76 an incidence of 9.7% [3,5]. Postpartum urinary retention can lead to urinary incontinence and  
77 detrusor atony, urinary tract infections, anuria, hydronephrosis, and even kidney failure [6–8].  
78 Although the pathophysiology of postpartum acute urinary retention is still unclear, many  
79 hypotheses and risk factors have been described as involved, including physiological,  
80 neurological, and mechanical causes [4,5]. Several risk factors have been suggested, such as  
81 preexisting risk factors (history of urinary retention, nulliparity), and additional risk factors  
82 related to epidural analgesia, iatrogenic fluid overload, patient BMI, the baby's birth weight, or  
83 vaginal delivery (labor duration, instrumental delivery, episiotomy, perineal edema) [9–11].  
84 Screening for PUR does not occur during standard postpartum care. Therefore, early recognition  
85 of risk factors is important in order to provide immediate management and prevent potential  
86 damage of an enduring retention. The objective of the present study was to identify risk factors  
87 for PUR in order to be able to provide prompt management avoiding further complications.

88

## 89 **Materials and Methods**

90

91 A retrospective, comparative, case-control study, including 2 groups of 96 patients who  
92 delivered vaginally between March 2011 and October 2015, was conducted in the obstetrics and  
93 gynecology department of the Women and Children's University Hospital (*Hôpital Femme Mère*  
94 *Enfant*) in Lyon, France. This study was approved by the French ethics committee, registered in  
95 the clinical trials register (N° **NCT03876756**) and declared to the National Commission on

96 Informatics and Liberty (CNIL, N° 17-020). All patients were informed about the use of their  
97 medical data for research purposes. Selection criteria for PUR were patients presenting no  
98 spontaneous voiding within 6 hours after delivery, associated with a PVRBV greater than 400  
99 ml, as previously defined [3,5,13]. The PVRBV was measured using a bladder scanner, operated  
100 by competent midwives. According to Peduzzi [12], a minimum of 90 patients were needed to  
101 analyze 9 factors in multivariate analysis. Between March 2011 and October 2015, all patients  
102 (n=96) presenting with PUR were selected for analysis based on data extraction from the medical  
103 records registry (BO / WEB100T - *Hospices Civils de Lyon*) of the obstetrics and gynecology  
104 department. The control group was selected respecting 1:1 matching criteria, and consists of 96  
105 patients without PUR that were paired according to the year of delivery and patient's age at  
106 delivery. Data concerning patient characteristics (maternal age, parity, primiparity, BMI before  
107 pregnancy, average weight gain), delivery characteristics (labor duration > 360 minutes,  
108 instrumental delivery, perineal tear), volume of iatrogenic fluid administered during labor, the  
109 period between delivery and the first voiding, characteristics of epidural anesthesia (volume of  
110 local anesthesia for epidural > 50ml, dose of local anesthesia for epidural > 50mg, duration  
111 of epidural anesthesia > 500 minutes) and perineal complications (hemorrhoids, vulvar edema,  
112 perineal hematoma) were collected. Medians of the following data were calculated to obtain a  
113 threshold value for further multivariate analysis: BMI before pregnancy, baby's birth weight,  
114 labor duration, volume of iatrogenic fluid administered during labor, period between delivery  
115 and the first voiding, volume of local anesthesia for epidural, dose of local anesthesia for  
116 epidural, and duration of epidural anesthesia. Threshold for second-stage duration was  
117 determined according to French guidelines [14]. The statistical analysis was performed using  
118 SAS software (SAS 9.4, SAS Institute Inc., Cary, NC, USA). After a Shapiro-Wilk's W test for  
119 normality of distribution of the data, continuous data were expressed as mean  $\pm$  standard  
120 deviation (SD) for normally distributed data, or median [interquartile range, IQR] for non-  
121 normally distributed data. Incidence data were expressed as number (percentage and 95%  
122 confidence interval, 95%CI) calculated according to Wald method. Statistical comparison using  
123 Fisher's exact test or  $\chi^2$  test as appropriate, and Student t test. A value of  $p < 0.05$  was  
124 considered statistically significant. A logistic regression analysis was performed in order to  
125 assess the risk factors for PUR, producing odds ratios (OR) with 95%CI. For the construction of  
126 the multivariable models, all variables associated ( $P < 0.1$ ) with PUR in univariate analysis and

127 clinically relevant were subjected to a stepwise logistic regression analysis. Potential  
128 confounding factors were eliminated if the *P* value was >0.1, but remained in the model if  
129 the *P* value was <0.05. If *p* value was >0.05 and <0.1 during stepwise logistic regression  
130 analysis, the variable was excluded from the final result but its value was taken into account for  
131 the calculation of the logistic regression model. Only categorical variables were taken into  
132 account in the multivariate analysis. The goodness-of-fit of the logistic regression for  
133 multivariate analysis was assessed using a Hosmer Lemeshow's chi-squared test. The predictive  
134 value of the multivariate analysis was assessed using the area under the ROC curve.

## 135 **Results**

136

137 Among the two groups of patients included in the study, the mean maternal age was  $29.2 \pm 4.8$   
138 years in the PUR group and  $29.4 \pm 4.9$  years in the control group ( $p=0.86$ ). A total of 63 patients  
139 (65.6%) from the PUR group and 38 (40%) from the control group were primiparous ( $p=0.0004$ ).

140 The mean labor duration was superior to 360 minutes for 58 patients (61%) in the PUR group vs.  
141 38 patients (40.9%) from the control group ( $p=0.006$ ) (Table 2). Among patients with labor  
142 exceeding > 360 min, 71 patients (74.0%) were primipare ( $p<0.0001$ ). In PUR group, 47 out of  
143 the 58 patients (81%) with labor duration > 360 min were primipare ( $p<0.0001$ ).

144 In the PUR group, 13 patients (13.5%) had urological antecedents and 3 (3.3%) had already  
145 presented an episode of PUR after vaginal delivery. In the PUR group, 10 (10.4%) patients had  
146 undergone previous caesarian section compared to 7 (7.4%) in the control group ( $p=0.47$ ). The  
147 mean gestational age at birth was  $39.2 \pm 2.2$  weeks in the PUR group and  $39 \pm 1.7$  weeks in the  
148 control group ( $p=0.64$ ; Table 1). More than half of the patients (58.3%) from the PUR group  
149 presented an excessive weight gain versus 44 patients (45.8%) from the control group ( $p=0.08$ ).  
150 The duration of second stage labor was more than 45 minutes for 12 patients (12.5 %) in the  
151 PUR group and 2 patients (2.1%) from the control group ( $p=0.006$ ; Table 2).

152 Instrumental delivery was performed in 36 patients (37.9 %) from the PUR group and 5 (5.3 %) from the control group ( $p<0.0001$ ). For PUR group, instrumental delivery for second stage  $\geq 45$   
153 min concerned 11 patients out of 12 (91.7%) and 25 patients out of 83 with second stage < 45  
154 min (30.1%) had instrumental delivery for fetal heart anomaly. Only 7 patients (7.3%) from the  
155

156 PUR group had no perineal lesion after delivery compared to 34 patients (35.8%) in the control  
157 group ( $p<0.0001$ ). The period between delivery and first voiding attempt was superior to 330  
158 minutes for 50 (52.1%) patients of the PUR group and none in the control group ( $p=0.01$ ).

159 Among the postpartum complications recorded, 23 patients (24%) from the PUR group and 2  
160 patients (2.1 %) from the control group presented with vulvar edema ( $p<0.0001$ ), and 29 patients  
161 (30.2%) from the PUR group and 6 patients (6.4 %) from the control group presented with  
162 hemorrhoids ( $p<0.0001$ ; Table 2).

163 Fluid administration during labor was higher than 1500 ml in 48 patients (50 %) from the PUR  
164 group and 33 patients (35.5 %) from the control group ( $p=0.04$ ; Table 3). More than one bladder  
165 catheterization was performed in the postpartum period for 21.9 % of patients in the PUR group  
166 and 5.3 % in the control group ( $p=0.0008$ ). Spontaneous voiding before leaving the delivery  
167 room occurred for 33 patients (34.4 %) in the PUR group and 64 patients (67.4 %) in the control  
168 group ( $p<0.0001$ ), while 41 patients (43.2 %) from the PUR group and 94 patients (99 %) from  
169 the control group had spontaneous voiding after leaving the delivery room ( $p<0.0001$ ; Table 3).

170 The majority of patients had an epidural anesthesia. The duration of epidural anesthesia was  
171 greater than 500 minutes in 51 patients (64.6 %) from the PUR group vs. 30 patients (42.1 %) from  
172 the control group ( $p=0.001$ ; Table 4). Bladder catheterization for PUR management was  
173 found to have a mean delay of  $10.5 \pm 10.0$  hours and a mean total duration of  $4 \pm 4.8$  days. The  
174 patients had a physiologic micturition within  $3.1 \pm 1.8$  hours after removal of the bladder  
175 catheter, with a mean PVRBV of  $205.1 \pm 285.2$  ml (Table 5).

176 Variables included in the multivariate analysis were: primiparity, absence of spontaneous  
177 voiding before leaving the delivery room, second stage  $\geq 45$  minutes, labor duration  $> 360$   
178 minutes, instrumental delivery, no intact perineum, iatrogenic fluid during labor  $> 1500$  ml,  
179 vulvar edema or perineal hematoma, and epidural anesthesia (Table 7). According to the logistic  
180 regression analysis performed, the factors related with the occurrence of PUR were instrumental  
181 delivery (OR 13.42, 95 %CI [3.34;53.86],  $p=0.0002$ ), absence of spontaneous voiding before  
182 leaving the delivery room (OR 6.14, 95%CI [2.56;14.73],  $p<0.0001$ ), no intact perineum (OR  
183 3.29, 95%CI [1.10;9.90],  $p=0.03$ ), and vulvar edema or perineal hematoma (OR 8.05, 95%CI  
184 [1.59;40.67],  $p=0.01$ ; Table 6).



185 The area under the ROC curve was 0.87 (95%CI: 0.82 – 0.93) indicating a high predictive value  
186 of the multivariate analysis. In the same way, the non-significant p value (p=0.57) of the Hosmer  
187 Lemeshow's chi-squared test reflects that the model is correctly specified.

## 188 **Comment**

189 During labor and in the postpartum period, the bladder is usually at risk for possible injuries and  
190 dysfunction creating the need for identifying specific risk factors for PUR. The present study  
191 showed that, following vaginal delivery, an increased risk of PUR was associated to instrumental  
192 delivery, the absence of spontaneous voiding before leaving the delivery room, the presence of  
193 vulvar edema, and a dose of local anesthetic superior to 50 mg.

194 Only vaginal operative delivery, which has been described as an important risk factor for PUR  
195 [15-18], was considered in the present study. Of note, the proportion of PUR patients undergoing  
196 an instrumental delivery was largely superior to that of the overall proportion observed in the  
197 department (13%). Hence, the use of instruments during vaginal delivery was found, herein, as  
198 an important risk factor for PUR, confirming previous results [15,16,19]. Moreover, perineal  
199 hematoma and edema represent classical risk factors for PUR by local compression mechanisms  
200 [20]. The results herein corroborate this statement since vulvar edema was found to be an  
201 independent risk factor for PUR.

202 Primiparity is one of the essential risk factors, directly related to the apparition of PUR  
203 [10,15,16]. It is very difficult to consider primiparity as an independent risk factor, since it is  
204 associated with the prolonged pressure exercised by the fetal head on the maternal soft tissues,  
205 which can result into soft tissue edema, stretching neuropathy, and trauma on the pelvic floor  
206 muscles [2,19]. In a study by Yip et al. conducted on 691 women who delivered vaginally, it was  
207 found that duration of labor over 800 minutes was significantly correlated with an increased risk  
208 of PUR [3]. In the present study, the mean duration of labor in the PUR group was higher than  
209 that of the control group and it was nearly half of that presented by Yip et al. However, labor  
210 duration did not appear as a significant risk factor during multivariate analysis.

211 Epidural analgesia is also considered a risk factor for PUR as it directly affects the sensitivity  
212 and contractility of the bladder [11,21]. Importantly, it has been noticed that the type of analgesic

213 product used (Morphine, Lidocaine, Catapresan) as well as the dose, plays an important role  
214 during post-partum voiding. Herein, it was observed that a high dose of local anesthesia (>50mg)  
215 increases the risk of PUR. Uro-dynamic tests revealed that the epidural analgesia inhibits bladder  
216 activity, by inhibition of the afferent Delta pathways [4,22]. Several authors have proposed a  
217 systematic indwelling catheterization for all patients undergoing epidural anesthesia during  
218 labor, in order to avoid the risks of a distended bladder [22]. This can be discussed taking into  
219 consideration the augmented risk of urinary infections associated with such an intervention [23].  
220 However, if such an intervention is envisioned, it is important to note that recent studies showed  
221 that the earlier the bladder catheter is removed, the less frequent PUR is [23].

222 Iatrogenic fluid overload during labor can lead to bladder overdistention and acute urinary  
223 retention [20]. Although it did not appear as a risk factor for PUR in the present study, it may be  
224 necessary, for future practice, to establish a limit for iatrogenic fluid administration, a timetable  
225 for the intermittent bladder catheterizations, or guidelines for catheterization according to the  
226 intravenous fluid intake.

227 The pain related with the repair of the episiotomy and perineal lacerations or with the presence of  
228 hemorrhoids may result in reflex urethral spasm and subsequent PUR [5]. In the present study  
229 nearly half of patients complained of pain the second day after delivery, hemorrhoids being the  
230 main cause for discomfort. In this context caution must be taken concerning the use of morphine-  
231 based drugs, taking into consideration their inhibitory action on bladder innervation.  
232 Nonsteroidal anti-inflammatory drugs should be considered at first intention.

233 The study has some limitations. The sample size and the case-control design may be associated  
234 with possible imprecision with potential selection bias due to retrospective data collection  
235 despite the use of medical electronic records. Also, this study was performed in a single center  
236 and reflects local patterns related to the experience of the medical team, hence minimizing the  
237 generalization of the present results. However, the study design was particularly appropriate for  
238 the assessment of the risk factors of postpartum urinary retention, a somewhat uncommon  
239 complication related to vaginal delivery.

240 Current guidelines do not recommend routine bladder scanning for the diagnosis of PUR due to  
241 the inaccuracy of ultrasound examination measurements which are operator-dependent, and due  
242 to the form of the bladder and size of the uterus during post-partum [19, 24]. Following the  
243 results of the present study, a change of practice is currently being implemented in the  
244 department. The obstetrical team has been sensitized to detect these risk factors in order to adapt  
245 management and an increase in the use of bladder scanning before leaving the delivery room has  
246 been observed. Setting up specific guidelines in each maternity represents an important goal that  
247 would allow standardization of current practices and a decrease in delay for diagnosis.

248

249

## 250 **Conclusion**

251 The present study identified risk factors for PUR that should be taken into consideration as soon  
252 as delivery is over in order to implement appropriate management. Future studies are needed to  
253 assess the contribution of early systematic bladder scanning in patients with risk factors for early  
254 diagnosis of PUR.

255

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258

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264

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**Table 1. Patient characteristics**

	PUR n=96	Control n=96	p
Maternal age (years)	29.2 ± 4.8	29.4 ± 4.9	0.86
Gravidity	1.7 ± 1.1	2.3 ± 1.3	0.001
Parity	1.5 ± 0.8	2.0 ± 1.2	0.0002
Primipara	63 (65.6%)	38 (40.0%)	0.0004
Gestational age (weeks)	39.2 ± 2.2	39.0 ± 1.7	0.64
BMI before pregnancy	22.9 ± 3.4	24.3 ± 4.6	0.02
Average weight gain (kgs)	13.8 ± 5.1	12.9 ± 6.8	0.27
Previous caesarian section	10 (10.4%)	7 (7.4%)	0.47
Urological history	13 (13.5%)	0 (0%)	0.0002
Antecedents of urinary retention	3 (3.3%)	0 (0%)	0.25
Symphyseal fundal height at 9 months (cm)	32.5 ± 1.9	32.3 ± 1.9	0.38

*Data are presented as mean ± standard deviation or number (%)*

*PUR: postpartum urinary retention*

*P < 0.05 was considered statistically significant*

**Table 2. Pregnancy, delivery, and post-partum related data**

	PUR n=96	Control n=96	p
Pathological pregnancy	25 (27.2%)	29 (30.8%)	0.58
Presentation			
anterior	77 (81.0%)	73 (79.8%)	
posterior	11 (11.6%)	16 (16.8%)	
transverse	7 (7.4%)	3 (3.2%)	
breech	0 (0%)	3 (3.2%)	0.13
Membrane rupture			
spontaneous	44 (45.8%)	45 (47.4%)	
artificial	51 (53.1%)	43 (45.3%)	
premature	1 (1.0%)	7 (7.4%)	0.07
Labor duration > 360 minutes	58 (61.0%)	38 (40.9%)	0.006
Second stage ≥ 45 minutes	12 (12.5%)	2 (2.1%)	0.006
Instrumental delivery	36 (37.9%)	5 (5.3%)	< 0.0001
forceps	22 (23.2%)	2 (2.1%)	
spatulas	0 (0%)	1 (1.0%)	
Kiwi ventouse	14 (14.7%)	2 (2.1%)	
Intact perineum	7 (7.3%)	34 (35.8%)	< 0.0001
episiotomy	53 (55.2%)	22 (23.2%)	
first-degree tear	24 (25.0%)	31 (32.6%)	
second-degree tear	9 (9.4%)	7 (7.4%)	
third-degree tear 3B	2 (2.1%)	1 (1.0%)	
third-degree tear 3C	1 (1.0%)	0 (0%)	
Manual revision of the uterine cavity	28 (29.2%)	13 (13.7%)	0.009
Birth weight of the baby (grams)	3312 ± 567	3330 ± 522	0.82
Baby's head circumference (cm)	34.8 ± 2.2	34.5 ± 1.4	0.20
Period between the delivery and first voiding attempt >330 minutes	50 (52.1%)	0 (0.0%)	0.01
Pain at day 1	47 (49.0%)	5 (5.3%)	< 0.0001
Hemorrhoids	29 (30.2%)	6 (6.4%)	< 0.0001
Vulvar edema	23 (24.0%)	2 (2.1%)	< 0.0001



Perineal hematoma	10 (10.4%)	1 (1.0%)	0.005
Early mobilization	88 (91.7%)	92 (96.8%)	0.12
Duration of hospital stay (days)	5.4 ± 2.2	3.6 ± 1.2	< 0.0001

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*Data are presented as mean ± standard deviation or number (%)*

*PUR: postpartum urinary retention*

*P < 0.05 was considered statistically significant*

**Table 3. Iatrogenic fluid administration during labor and bladder catheterization**

	PUR n=96	Control n=96	p
Iatrogenic fluid during labor > 1500 ml	48 (50.0%)	33 (35.5%)	0.04
Bladder catheterization during labor	70 (74.5%)	75 (79.0%)	0.47
Post-partum bladder catheterization	61 (63.5%)	49 (51.6%)	0.09
Post-partum bladder catheterization >1	21 (21.9%)	5 (5.3%)	0.0008
Spontaneous voiding before leaving the delivery room	33 (34.4%)	64 (67.4%)	< 0.0001
Spontaneous voiding after leaving the delivery room	41 (43.2%)	94 (99.0%)	< 0.0001

*Data are presented as mean ± standard deviation or number (%)*

*PUR: postpartum urinary retention*

*P < 0.05 was considered statistically significant*

**Table 4. Characteristics of epidural anesthesia**

	PUR n=96	Control n=96	p
Epidural anesthesia	83 (91.2%)	85 (98.8%)	0.03
Test dose	83 (97.6%)	84 (98.8%)	1.00
PCEA	78 (92.9%)	73 (85.9%)	0.14
Local anesthetic for epidural anesthesia			
Ropivacaine	66 (78.6%)	63 (74.1%)	
Levobupivacaine	18 (21.4%)	22 (25.9%)	0.49
Sulfentanil	80 (95.2%)	78 (91.8%)	0.36
Clonidine	16 (19.0%)	22 (25.9%)	0.29
Complementary bolus of local anesthesia	30 (35.7%)	14 (16.5%)	0.004
Epidural anesthesia extension	33 (37.5%)	18 (21.2%)	0.02
Local anesthesia for extension	33 (94.3%)	18 (100%)	0.54
Sulfentanil for extension	2 (6.2%)	0 (0%)	0.54
Reason for extension			
forceps	18 (48.6%)	3 (17.6%)	
perineal tear suture	3 (8.1%)	1 (5.9%)	
manual removal of the placenta	9 (24.3%)	10 (58.8%)	
other	7 (18.9%)	3 (17.6%)	0.07
Morphine	7 (8.0%)	0 (0%)	0.01
Spinal anesthesia	7 (7.7%)	2 (2.3%)	0.17
Morphine PCA	2 (2.2%)	0 (0%)	0.50
Volume of local anesthesia for epidural > 50 ml	47 (55.9%)	35 (41.2%)	0.05
Dose of local anesthesia for epidural > 50 mg	52 (61.2%)	32 (37.6%)	0.002
Duration of epidural anesthesia > 500 minutes	51 (64.6%)	30 (39.5%)	0.001

*Data are presented as mean ± standard deviation or number (%)*

*PUR: postpartum urinary retention*

*PCEA: Patient controlled epidural analgesia*

**Table 5. PUR management data**

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Delay of bladder catheterization (hours)	10.5 ± 10.0
Duration of bladder catheterization (days)	4.0 ± 4.8
Number of bladder catheterizations	1.2 ± 0.6
Diagnostic post void bladder residual volume (ml)	757.6 ± 373.2
Post void residual volume after bladder catheterization (ml)	205.1 ± 285.2
First micturition after the removal of the bladder catheter (hours)	3.1 ± 1.8
Patients discharged with a bladder catheter	10 (10.5%)

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*Data are presented as mean ± standard deviation or number (%)*

*PUR: postpartum urinary retention*

*P < 0.05 was considered statistically significant*

**Table 6. Risk factors associated to PUR**

	OR [95 %CI]	p
Instrumental delivery	13.42 [3.34;53.86]	0.0002
Absence of spontaneous voiding before leaving the delivery room	6.14 [2.56;14.73]	< 0.0001
No intact perineum	3.29 [1.10;9.90]	0.03
Vulvar edema or perineal hematoma	8.05 [1.59;40.67]	0.01

*OR: odds ratio*

*CI: confidence interval*

**Table 7.** Logistic regression results

	OR [95 % CI]	<b>p</b>
Primiparity	1.24 [0.46;3.29]	0.67
Absence of spontaneous voiding before leaving the delivery room	6.01 [2.44;14.81]	<0.0001
Second stage $\geq$ 45 minutes	0.61 [0.04;9.35]	0.72
Labor duration > 360 minutes	1.46 [0.58;3.69]	0.42
Instrumental delivery	13.50 [2.59;70.22]	0.002
No intact perineum	2.44 [0.72;8.22]	0.15
Iatrogenic fluid during labor > 1500 ml	1.69 [0.70;4.07]	0.24
Vulvar edema or perineal hematoma	8.49 [1.69;42.57]	0.009
Epidural anesthesia	<0.001[<0.001;>999.999]	0.99

*OR: odds ratio*

*CI: confidence interval*