



# Factors Affecting Postpartum Overt and Covert Urinary Retention After Vaginal Delivery

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## Abstract

**Objectives:** The aim of this study was to investigate the factors affecting postpartum urinary retention (PPUR) following vaginal delivery.

**Materials and Methods:** This cross-sectional analytical study measured the post-void residual (PVR) urine volume by ultrasound, at most, 15 minutes after the first urination after delivery. Women with a PVR >150 mL without urinary symptoms were assigned to the postpartum covert urinary retention group. Data were analyzed with SPSS22. The chi-square and Mann-Whitney tests were used for quantitative and qualitative variables, respectively.

**Results:** In this study, 1120 patients had a normal delivery at Ayatollahs Rouhani hospital from 21 January 2016 to 20 January 2017. Of this number, 306 (29.4%) and 734 (70.6%) cases with and without urinary retention were allocated to the case and control groups, respectively. Women with instrumental delivery had 30.19 times ( $P=0.003$ ) higher odds of urinary retention. Instrumental delivery is one of the known risk factors of urinary retention. The linear effect of the total length of labor was also measured, and the results revealed that every one-minute increase in the total length of labor increases the odds of covert urinary retention by 1.008 times ( $P<0.001$ ).

**Conclusions:** The findings of the study showed that various factors are involved in the incidence of urinary retention. More precisely, instrumental delivery, birth weight, gestational age, and other factors can each be a risk factor for urinary retention.

**Keywords:** Urinary retention, Women, Pregnancy, Instrumental delivery, Urinary symptoms, Body mass index

## Introduction

Postpartum voiding problems and urinary retention are highly common. Timely diagnosis and appropriate treatment are important in the rapid return of normal bladder function (1). The prevalence of acute postpartum urinary retention (PPUR) is reported from 1.7 to 17.9% (2, 3). Incomplete voiding, incomplete bladder emptying, and overflow incontinence are the symptoms of urinary retention. Prolonged urinary retention complications include infection, chronic urination problems, and kidney failure (4). Yip et al first expressed the distinction between overt and covert urinary retention in 1997 (3). Overt PPUR is identified by the absence of urination within six hours of vaginal delivery or after the withdrawal of the urinary catheter following cesarean section. Covert urinary retention is determined by the post-void residual (PVR) measurements of  $\geq 150$  mL after spontaneous urination determined by ultrasound or by catheterization (3). The exact etiology of PPUR is unclear (1,5) because there are few quantitative studies in this regard (5). Thus, it is important to detect and remove the risk factors of PPUR since persistent PPUR requires long-term catheterization

or incurs irreversible damage to the genitourinary system (6). Therefore, the present study aimed to investigate factors affecting PPUR after vaginal delivery at Ayatollah Rouhani Hospital in Babol, Iran.

## Materials and Methods

This cross-sectional study recruited all women who had normal delivery at Ayatollah Rohani Hospital in Babol Iran from 21 January 2016 to 20 January 2017. After the approval of the proposal, the study was initiated following obtaining permission from the Ethics Committee of Babol University of Medical Sciences, along with written consent from eligible subjects. The inclusion criteria were vaginal delivery or instrumental vaginal delivery, gestational age more than 35 weeks, and birth weight of 2300-4500 g. On the other hand, the exclusion criteria were a PVR  $\leq 150$  mL on the second day, cesarean section, required Foley catheter during labor and after delivery for any reason other than urinary retention, postpartum bleeding and infection, serious postpartum complications, and the mother's unstable vital signs after childbirth. Of 1120 patients participating in the study, 80 cases were excluded

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**Key Messages**

- ▶ Postpartum voiding problems and urinary retention are highly common
- ▶ The present study aimed to investigate factors affecting PPUR after vaginal delivery
- ▶ The various factors are involved in the incidence of overt or covert urinary retention, including instrumental delivery, birth weight, gestational age, and other factors.

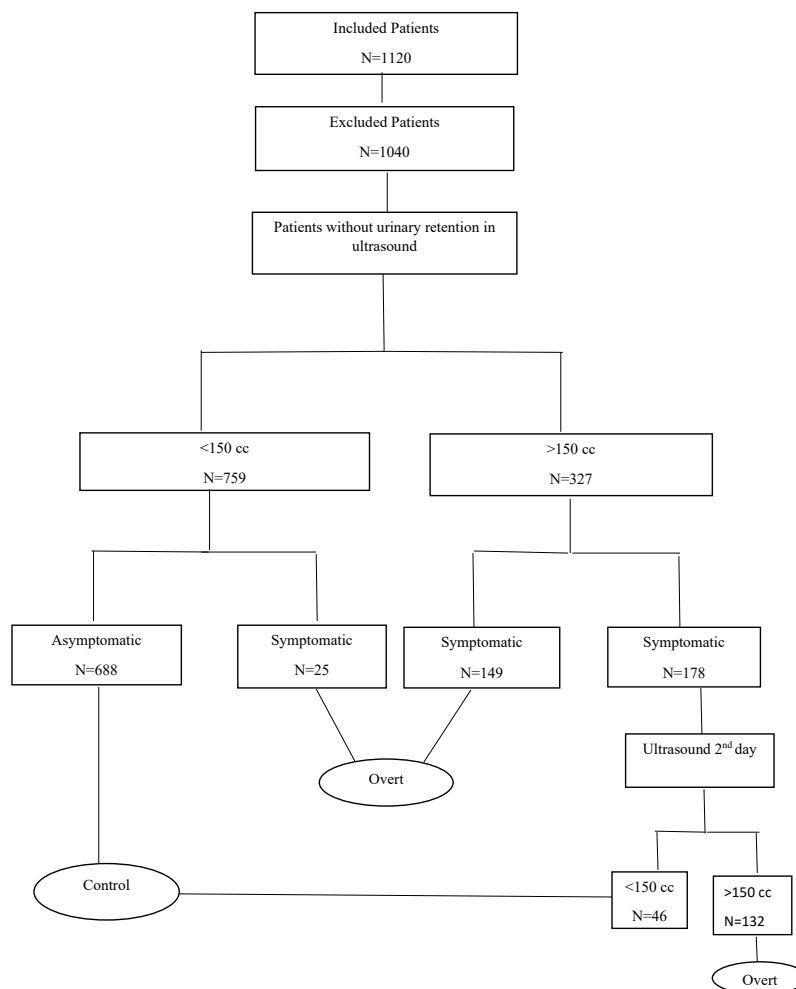
and the remaining 1040 cases were enrolled in the study. The inclusion algorithm is detailed in Figure 1. The demographic characteristics of all eligible women were recorded in a checklist. PVR was measured by ultrasound, at most, 15 minutes after the first urination following delivery (by a trained and certified junior ultrasound specialist resident). An ultrasound (Honda™) device and the following formula were used to measure the urine volume:

$$Volume \pi = (D1 \times D2 \times D3) / 6$$

where D1, D2, and D3 represent the widest cross-

sectional diameter of the bladder, the anterior-posterior diameter of the bladder, and the widest head to tail bladder diameter, respectively, and  $\pi=22.7$  cm. These individuals were subjected to catheterization in the presence of urinary volume  $\geq 100$  mL, and PVR was precisely quantified by catheterization. In this study, PPUR was defined as the presence of  $\geq 150$  mL of urine in the bladder after urination. Women with urinary obstruction symptoms such as strain during urination, a feeling of incomplete bladder emptying, or failure to urinate were assigned to the overt PPUR group (7). Those with a  $PVR > 150$  mL without urinary symptoms were allocated to the postpartum covert urinary retention group.

Women with overt urinary retention (i.e., no urination within six hours after delivery) were catheterized for 48 hours, and PVR was examined after spontaneous urination following removing the catheter. The subject was discharged with a Foley catheter if PVR was  $> 150$  mL. On the second day after delivery, PVR was measured again in women with overt and covert urinary retention. In asymptomatic individuals, covert urinary retention was rejected if PVR was  $< 150$  mL, and those with a  $PVR > 150$  mL were included in the study. All cases of overt urinary



**Figure 1.** The Inclusion Algorithm.

retention were also included, and the phone number of all the participating women with urinary retention (overt or covert) was obtained as well. Three months after delivery, they were visited and assessed in terms of urinary problems and symptoms such as urgency, stress incontinence, urge incontinence, and weak urine stream. Then, different data were collected, including maternal and gestational age, the number of deliveries, pregnancy and abortion, obstetrics history (preeclampsia and diabetes), and history of labor (type of previous deliveries, birth weight of previous children, or PPUR in previous deliveries). Moreover, other information regarding the current delivery was obtained, encompassing the use of spinal anesthesia, birth weight, instrumental delivery, episiotomy (midline or mediolateral), vaginal damage, oxytocin-induced labor pain, the mother's body mass index, the length of first, second, and third stages of labor in minutes, and PVR in mL. Data were analyzed in both groups with and without urinary retention in SPSS software, version 22. Finally, chi-square and Mann-Whitney tests were used for quantitative and qualitative variables, respectively, and  $P < 0.05$  was considered statistically significant.

## Results

According to the algorithm, 132 subjects had a PVR  $> 50$  mL and were asymptomatic on the second day after delivery while 46 subjects had a PVR  $< 150$  mL and the symptoms of urinary retention.

Women with and without urinary obstruction symptoms were categorized into overt and covert PPUR groups, respectively. In general, 132 (43.1%) and 174 (56.9%) cases had covert and overt urinary retention, respectively. No other regional anesthesia has been used in this study except for spinal anesthesia.

Among 174 patients with urinary symptoms in the overt urinary retention group, urinary straining was the most common with 91 (51.1%) cases while urge incontinence was the least common with 2 cases (1.1%), the related data of which are shown in Figure 2.

Tables 1 and 2 present the relationship between different

factors in patients with covert and overt urinary retention and the control group. Based on the results, there was a significant relationship between all demographic and some clinical variables in the two groups.

Of 132 patients with covert urinary retention, 88 (66.7%) cases had symptoms three months postpartum. Fifty-one cases reported urinary straining and 32 (24.2%) of them indicated a feeling of incomplete bladder emptying as a sign of urinary retention. Of 174 cases with urinary retention, 32 (18.4%) cases had no symptoms after three months whereas other patients had symptoms such as straining (62 cases, 35.6%) and a feeling of incomplete bladder emptying (60 cases, 34.5%), the details of which are illustrated in Figure 3.

Table 3 provides the multivariate analysis of the effect of variables on one another in the covert urinary retention and control groups. The odds of covert urinary retention in women with 39-40 weeks of pregnancy were 0.13 times as in women with 35-36 weeks of pregnancy ( $P = 0.001$ )

The odds of covert urinary retention in women having 3-4 previous deliveries were 0.009 times as in those without previous deliveries ( $P = 0.01$ ).

Every minute of an increase in the length of the second stage of labor increased the odds of covert urinary retention by 1.06 times ( $P = 0.01$ ). The linear effect of the total length of labor was also measured, and every minute increase in the total length of labor led to an increase in the odds of covert urinary retention by 1.008 times ( $P < 0.001$ ).

According to data in Table 4, the risk of overt urinary retention in women aged 20-25 was 6.91 times, more, 4.17 times more, and it was 3.02 times more in women aged 31-35 compared to under 20 women ( $P = 0.001$ ). The odds of overt urinary retention in women of 38-39 weeks of pregnancy were 0.39 times as in women with 35-36 weeks of pregnancy ( $P = 0.007$ ). The odds of overt urinary retention in women with 38-39 weeks of pregnancy were 0.45 times as in women with 35-36 weeks of pregnancy ( $P = 0.01$ ). Moreover, the odds of overt urinary retention in women having 3-4 previous deliveries were 0.13 times as in those without previous deliveries ( $P < 0.001$ ). In this case,

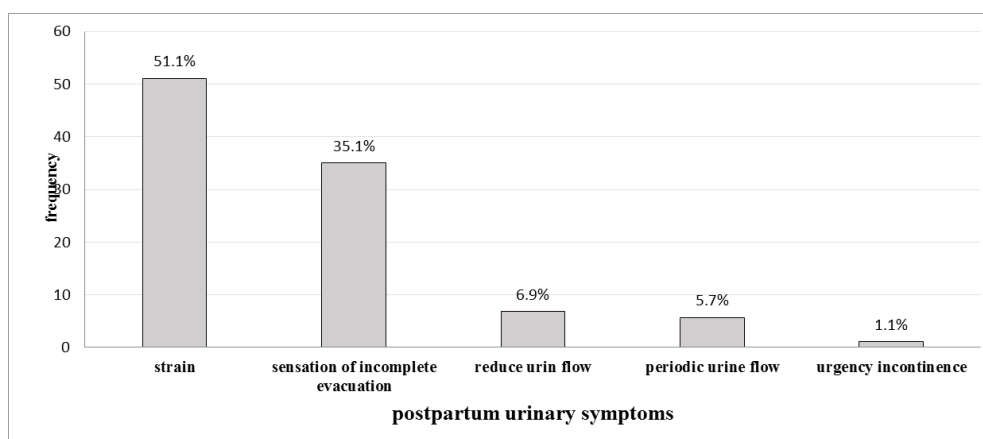


Figure 2. Frequency Distribution of Postpartum Urinary Symptoms in the Subjects.

**Table 1.** Relationship of Different Variables Between Patients in the Covert Urinary Retention and Control Groups

Variables	Control Group N (%)	Case Group N (%)	P Value
Age (y)			
<20	70 (9.5%)	34 (11.1%)	0.03
20-25	183 (24.9%)	65 (21.2%)	
26-30	342 (46.6%)	125 (40.8%)	
31-35	80 (10.9%)	52 (17.0%)	
36-40	59 (8.0%)	30 (9.8%)	
Gestational age (wk)			
35-36	156 (21.3%)	30 (9.8%)	<0.001
36-37	23 (3.1%)	13 (4.2%)	
37-38	54 (7.4%)	14 (4.6%)	
38-39	188 (25.6%)	101 (33.0%)	
39-40	313 (42.6%)	148 (48.4%)	
History of delivery			
No history of delivery	277 (37.7%)	107 (35.0%)	<0.001
1-2	317 (43.2%)	109 (35.6%)	
3-4	42 (5.7%)	87 (28.4%)	
>5	98 (13.4%)	3 (1.0%)	
Mode of delivery			
No history of delivery	277 (37.7%)	107 (35.0%)	<0.001
Cesarean	9 (1.2%)	13 (4.2%)	
Normal vaginal delivery	447 (60.9%)	180 (58.8%)	
Normal vaginal delivery+ Instrument	1 (0.1%)	6 (2.0%)	
Abortion			
No	640 (87.2%)	241 (78.8%)	<0.001
1	58 (7.9%)	57 (18.6%)	
2	36 (4.9%)	8 (2.6%)	
History of diabetes in pregnancy			
Yes	10 (1.4%)	45 (14.7%)	<0.001
No	724 (98.6%)	261 (85.3%)	
History of preeclampsia in pregnancy			
Yes	11 (1.5%)	25 (8.2%)	<0.001
No	723 (98.5%)	281 (91.8%)	
Retention of urinary in previous delivery			
Yes	2 (0.3%)	3 (1.0%)	0.15
No	732 (99.7%)	303 (99.1%)	
Spinal anesthesia			
Yes	2 (0.3%)	16 (5.2%)	<0.001
No	732 (99.7%)	290 (94.8%)	
Neonate weight (kg)			
2-2.5	104 (14.2%)	63 (20.6%)	0.001
2.5-3	255 (34.7%)	239 (73.9%)	
3-3.5	183 (24.9%)	96 (31.4%)	
3.5-4	63 (8.6%)	32 (10.5%)	
4-4.5	129 (17.6%)	42 (13.7%)	
Body mass index (kg/m <sup>2</sup> )			
Thin	31 (4.2%)	-	<0.001
Normal	212 (28.9%)	97 (31.7%)	
Overweight	298 (40.6%)	140 (45.8%)	
Fatty	193 (26.3%)	69 (22.5%)	

Table 1. Continued

Variables	Control Group No. (%)	Case Group No. (%)	P Value
Normal vaginal delivery			
+ Instrument	1 (0.1%)	16 (5.2%)	
Yes	733 (99.9%)	290 (94.8%)	<0.001
No			
Episiotomy			
Yes	633 (86.2%)	285 (93.1%)	0.001
No	101 (13.8%)	21 (6.9%)	
Damage to the delivery channel			
Yes	2 (0.3%)	3 (1.0%)	0.15
No	732 (99.7%)	303 (99.0%)	
Induction and accretion with oxytocin			
Yes	370 (50.4%)	186 (60.8%)	0.003
No	364 (49.6%)	120 (39.2%)	
Length of the first stage of labor (min)	644.55±103.95	599.61±106.77	<0.001
Length of the second stage of labor (min)	38.37±11.48	33.40±12.16	<0.001
Length of the third stage of labor (min)	4.09±0.79	4.20±0.77	0.05
Total length of labor (min)	687.02±106.86	637.21±104.67	<0.001

Table 2. Relationship of Different Variables Between Patients in Overt Retention and Control Groups

Variables	Control Group No. (%)	Case Group No. (%)	P Value
Age (y)			
<20	70 (9.5%)	27 (15.5%)	
20-25	183 (24.9%)	27 (15.5%)	
26-30	342 (46.6%)	76 (43.7%)	0.008
31-35	80 (10.9%)	27 (15.5%)	
36-40	59 (8.0%)	17 (9.8%)	
Gestational age (wk)			
35-36	156 (21.3%)	25 (14.4%)	
36-37	23 (3.1%)	9 (5.2%)	
37-38	54 (7.4%)	4 (2.3%)	0.007
38-39	188 (25.6%)	56 (32.2%)	
39-40	313 (42.6%)	80 (46.0%)	
History of delivery			
No history of delivery	277 (37.7%)	65 (37.4%)	
1-2	317 (43.2%)	62 (35.6%)	
3-4	42 (5.7%)	(27.0%)	<0.001
>5	98 (13.4%)		
Mode of delivery			
No history of delivery	277 (37.7%)	65 (37.4%)	
Cesarean	9 (1.2%)	4 (2.3%)	
Normal vaginal delivery	447 (60.9%)	101 (58.0%)	<0.001
Normal vaginal delivery+ Instrument	1 (0.1%)	4 (2.3%)	
Abortion			
No	640 (87.2%)	141 (81.0%)	
1	58 (7.9%)	29 (16.7%)	<0.001
2	36 (4.9%)	4 (2.3%)	

Table 2. Continued

Variables	Control Group No. (%)	Case Group No. (%)	P Value
History of diabetes in pregnancy			
Yes	10 (1.4%)	30 (17.2%)	<0.001
No	724 (98.6%)	144 (82.8%)	
History of preeclampsia in pregnancy			
Yes	11 (1.5%)	19 (10.9%)	<0.001
No	723 (98.5%)	155 (89.1%)	
Retention of urinary in previous delivery			
Yes	2 (0.3%)		0.15
No	732 (99.7%)	174 (100%)	
Spinal anesthesia			
Yes	2 (0.3%)	7 (4.0%)	<0.001
No	732 (99.7%)	167 (96.0%)	
Neonate weight (Kg)			
2-2.5	104 (14.2%)	25 (14.4%)	0.430
2.5-3	255 (34.7%)	48 (27.6%)	
3-3.5	183 (24.9%)	50 (28.7%)	
3.5-4	63 (8.6%)	18 (10.3%)	
4-4.5	129 (17.6%)	33 (19.0%)	
Body mass index (Kg/m <sup>2</sup> )			
Thin	31 (4.2%)	-	<0.001
Normal	212 (28.9%)	55 (31.6%)	
Overweight	298 (40.6%)	78 (44.8%)	
Fatty	193 (26.3%)	41 (23.6%)	
Normal vaginal delivery			
+ Instrument	1 (0.1%)	7 (4.0%)	<0.001
Yes	733 (99.9%)	167 (96.0%)	
No			
Episiotomy			
Yes	633 (86.2%)	169 (97.1%)	0.001
No	101 (13.8%)	5 (2.9%)	
Damage to the delivery channel			
Yes	2 (0.3%)	3 (1.7%)	0.050
No	732 (99.7%)	171 (98.3%)	
Induction and accretion with oxytocin			
Yes	370 (50.4%)	119 (68.4%)	0.003
No	364 (49.6%)	55 (31.6%)	
Length of the first stage of labor (min)	644.55±103.95	614.83±107.21	<0.001
Length of the second stage of labor (min)	38.37±11.48	34.86±12.84	<0.001
Length of the third stage of labor (min)	4.09±0.79	4.17±0.78	0.230
Total length of labor (minute)	687.02±106.86	653.83±102.29	<0.001

3-4 previous deliveries were a protective factor. The linear effect of the total length of labor was also calculated, and every minute increase in the total length of labor increased the odds of urinary retention by 1.006 times ( $P<0.001$ ).

## Discussion

The results indicated that variables of being at 20 and 30 seconds, gestational age of 38 weeks or more, and gestational diabetes affect the occurrence of urinary

retention. Furthermore, birth weights of 2.5-3 and 4-4.5 kg are the risk factors for urinary retention. Instrumental delivery, oxytocin-induced labor pain, increased length of the second stage of labor, and the total length of labor are the risk factors for urinary retention.

PPUR is a problem with physical and psychological consequences for women. Several studies focused on factors affecting the incidence of urinary retention. Yip et al, Andolf et al, and Carley et al reported physiological changes

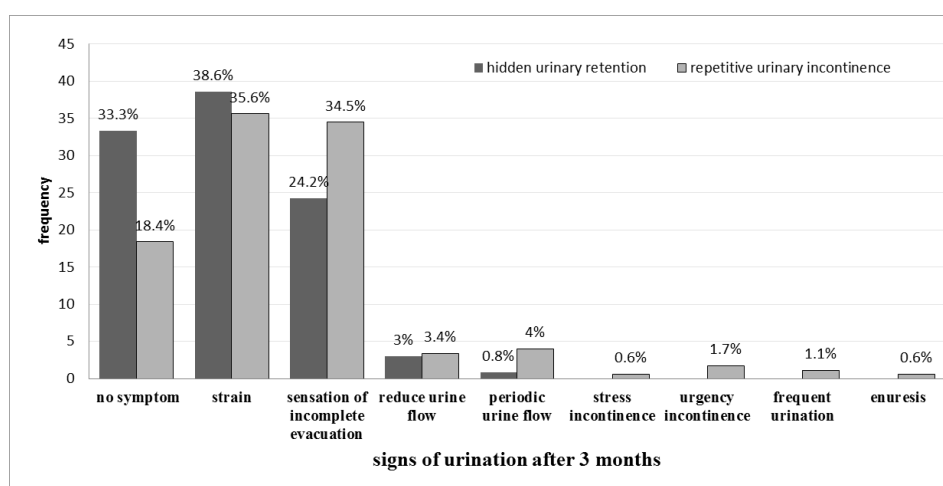


Figure 3. Frequency Percentage of Urinary Retention Symptoms After 3 Months in Patients With Covert and Overt Urinary Retention.

during pregnancy, regional anesthesia, instrumental delivery, perineal trauma, nulliparity, and prolonged labor as some of the risk factors for PPUR (3,8,9). Ching-Chung et al examined the relationship between women's various parameters and PPUR and found that age, birth weight, and fetal head circumference were not different between the two groups (10). However, mothers in the age groups of 20-25 and 26-30 are at risk of urinary retention. Birth weight (2.5-3 and 4.4-5 kg) affected the urinary retention in this study. It appears that the difference in the

Table 3. Logistic Regression of the Examined Variables in the Study of Covert Urinary Retention

Variables	95% CI	OR	P Value
Gestational age (wk)			
35-36	-	-	0.005
36-37	0.02-0.78	0.14	0.02
37-38	0.07-1.19	0.29	0.08
38-39	0.08-0.94	0.28	0.04
39-40	0.04-0.43	0.13	0.001
History of delivery			
No history of delivery	-	-	<0.001
1-2	0.001-3.59	0.07	0.18
3-4	0.001-0.45	0.009	0.01
>5	0.02-62.73	1.28	0.89
Abortion			
No	-	-	<0.001
1	0.10-0.51	0.23	<0.001
2	0.30-12.40	1.92	0.49
History of diabetes in pregnancy	7.98-52.30	10.30	<0.001
Spinal anesthesia	1.98-2.33	21.56	0.01
Neonate weight (kg)			
2-2.5	-	-	0.001
2.5-3	2.14-11.93	5.06	<0.001
3-3.5	0.65-2.79	1.35	0.41
3.5-4	0.96-7.94	2.76	0.06
4-4.5	2.23-17.71	6.28	0.001
Normal vaginal delivery + instrument	18.28-6515.365	345.11	<0.001
Length of the second stage of labor (min)	1.03-1.09	1.06	0.01
Total length of labor (min)	1.005-1.01	1.008	<0.001

Note. CI: confidence interval; OR: odds ratio.

environment, society, and sample size is one of the reasons for the reported differences in the studies. It should be mentioned that the infants' head circumference was not measured, which is a limitation of the study.

Carley et al reported that PPUR was more prevalent in primigravidas compared to multigravidas. They further stated that primigravidas had higher rates of instrumental delivery. Primigravidas more often received regional anesthesia and episiotomy. In other words, instrumental delivery, regional anesthesia, and episiotomy are risk

Table 4. Logistic Regression of the Examined Variables in the Study of Overt Urinary Retention

Variables	95% CI	OR	P Value
Age (y)			
<20	-	-	<0.001
20-25	2.93-16.28	6.91	<0.001
26-30	2.009-8.69	4.17	<0.001
31-35	1.24-7.19	2.98	0.01
36-40	0.76-5.40	2.02	0.15
Gestational age (wk)			
35-36	-	-	0.04
36-37	0.23-2.14	0.71	0.55
37-38	0.37-5.62	1.45	0.58
38-39	0.20-0.77	0.39	0.007
39-40	0.23-0.87	0.45	0.01
History of delivery			
No history of delivery	-	-	<0.001
1-2	0.85-2.33	1.41	0.17
3-4	0.07-0.25	0.13	<0.001
>5	-	-	0.99
Abortion			
No	-	-	0.01
1	0.18-0.73	0.37	0.004
2	0.39-6.26	1.57	0.51
History of diabetes in pregnancy	14.12-110.04	39.41	<0.001
Spinal anesthesia	1.25-64.09	8.96	0.02
Episiotomy	4.36-42.98	14.11	<0.001
Induction and accretion with oxytocin	2.45-6.46	3.98	<0.001
Total length of labor (minute)	1.004-1.009	1.006	<0.001

Note. CI: confidence interval; OR: odds ratio.



factors for urinary retention (9). Similarly, Saultz et al demonstrated that nulliparity is considered a risk factor for urinary retention (2). In another study on urinary retention, Ching-Chung et al reported that nulliparity, prolonged labor, and instrumental delivery were considered risk factors for urinary retention (10), which is in line with the results of the present study. Yip et al represented a longer labor length in the first and second stages of labor in women with urinary retention (3). In this study, the risk of urinary retention during the second stage and the total length of labor were 1.02 and 1.006, respectively. Likewise, Kekre et al found that the mean length of labor was significantly higher in women with urinary retention (11).

According to the results of this study and other studies, instrumental delivery is one of the risk factors for urinary retention. In two different studies, Carley et al and Liang et al, reported that instrumental delivery was associated with a higher incidence of urinary retention (9,12). Kekre et al also confirmed the increased incidence of urinary retention in women who had instrumental delivery (11). In the present study, instrumental delivery increased the risk of urinary retention by 30 times, which corroborates with the findings of Yip et al (3).

The results revealed that spinal anesthesia is a risk factor for urinary retention. In a similar study, Liang et al investigated the effect of epidural anesthesia on the incidence of urinary retention and stated that epidural anesthesia can influence the length of labor, thus affecting the incidence of urinary retention (12). Teo et al found that women receiving regional anesthesia experienced urinary retention 6.33 times as in other women (13).

The prevalence of overt and covert urinary retention in this study was 56.9% and 43.1%, respectively. Yip et al reported that 4.9% and 9.7% of overt and covert PPUR on the first day after delivery among 690 patients, respectively (3). However, the total incidence of urinary retention was 14.6%. In this study, an incidence of 14.6% of urinary retention was observed among all patients. This amount is significantly higher than that of the above-mentioned study. This is associated with different conditions in the two populations, including differences in facilities and culture of vaginal delivery.

Using multivariate regression, Mulder et al found that episiotomy, epidural anesthesia, and birth weight were independently effective in the incidence of covert urinary retention (6). In this study, the odds of covert urinary retention in patients with spinal anesthesia were 49.81 times more. On the other hand, episiotomy was not effective in the incidence of covert urinary retention in this study. The odds of covert urinary retention in mothers giving birth to a 2.5-3 kg infant were 5.06 times as in those who gave birth to a 2-2.5 kg infant. Previous research suggested various hypotheses for PPUR, including anatomical and hormonal changes during pregnancy (14).

A limitation of this study was the lack of long-term

follow-ups. No regional anesthesia has been used in this study except for spinal anesthesia, thus it was impossible to assess its effects on urinary retention.

Accordingly, it is recommended that a prospective study be conducted to examine significant variables on urinary retention one by one to accurately assess their predictive effect for use in preventive programs.

## Conclusions

The results of this study revealed that various factors are involved in the incidence of overt or covert urinary retention, including instrumental delivery, birth weight, gestational age, and other factors. Ultimately, women 30 years or less are at the risk of urinary retention. Women in the 38th week of pregnancy and above are at risk, as well. Finally, diabetes, spinal anesthesia, birth weight, instrumental delivery, oxytocin induced labor pain, and the length of the second stage and the total length of labor are the risk factors derived from this study.

## Authors' Contribution

AGH was responsible for conceptualization and methodology, ZB and AGH designed the study and led the conduction of the research. FM took part in investigation and formal analysis of the results. SHB and FAKH contributed in validation and analyses of the obtained results of the study. All authors contributed to writing—original draft preparation and review and editing; all authors approved the final manuscript and take responsibility for the integrity of the data.

## Conflict of Interests

Authors declare that they have no conflict of interests.

## Ethical Issues

The Ethics Committee of Babol University of Medical Sciences approved the study (Code: MUBABO.HRI.REC.1395.24).

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