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ORIGINAL ARTICLE

Covert postpartum urinary retention: causes and consequences (PAREZ study)

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Abstract

Introduction and hypothesis Increased post-voiding residual volume (PVRV), known as covert postpartum urinary retention (PUR), is an asymptomatic condition with unknown long-term adverse effects. The objectives were to determine the frequency of this phenomenon 3 days after delivery and to examine the associated risk factors and consequences of the increased residuum on women´s health 6 weeks postpartum.

Methods We carried out a prospective observational study including a total of 926 primiparous women, giving birth to singletons. All participants underwent ultrasound determination of PVRV on day 3 postpartum. Then, risk factors were determined using logistic regression analysis. After 6 weeks, participants were invited to return for PVRV determination and to complete urogynecological and general health questionnaires. Using these data, the consequences of increased PVRV were determined.

Results A total of n=90 women were diagnosed with abnormal PVRV. Mean age in the studied population was 30.4 years, BMI prior to delivery 27.8, weight of the newborn 3,420 g, and percentage of cesarean sections 15.9%. Gestational week (p=0.043), vaginal tear (p=0.032), and induction of labor (p=0.003) were risk factors for covert PUR. Puerperal incidence of urinary tract infection was 1.1% (6 out of 526) and of urinary incontinence 29.2% (155 out of 530), with no differences between the groups. In the second examination, covert PUR was no longer present, and the values of residual urine decreased for all patients in the case group. No statistically significant differences were observed in questionnaire scores in general health and wellbeing perceptions between the groups.

Conclusions We have found a few significant obstetrical–pediatric risk factors for abnormal PVRVs. Data from the follow-up suggest that covert PUR has no impact on morbidity and quality of life 6 weeks postpartum. Therefore, abnormal PVRV is a self-limited phenomenon with a tendency toward self-correction. Our findings support those of previous studies that advocate against screening for asymptomatic retention in the postpartum period, despite some similar previous recommendations.

Keywords Labor · Puerperium · Urinary incontinence · Urinary infection · Urinary retention · Vaginal delivery

Introduction

Postpartum urinary retention (PUR) is a common condition in the immediate postpartum period with incidence ranging from 0.28% to 36% [1, 2]. According to clinical demonstration, PUR is classified as overt, which is defined as the inability to void spontaneously within 6 h of either vaginal delivery or catheter removal after delivery, and covert. The covert form can be identified by elevated post-voiding residual volume (PVRV) measurements, using ultrasound scanning or catheterization after urination. The exact cut-off value is debated: usually women with PVRVs of more than 100 or 150 ml and no symptoms of urinary retention are in this category [2, 3]. Overt or symptomatic urinary retention is easily detectable, with clear clinical appearance, and therefore is adequately treated.

However, the covert form often remains undiagnosed as screening in the postpartum period is not routinely provided. Unified guidelines do not exist with respect to postpartum bladder care and systematic ultrasound screening of covert urinary retention. Some authors recommend repeated

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postpartum ultrasound bladder monitoring in all women at least until day 3 to avoid excessive urine retention [2], whereas others suggest that ultrasound examination might have no place in normal postpartum care [4]. Systematic review and meta-analysis of multiple studies could not provide clinical recommendations owing to different methods used and concluded that based on current literature, evidence stating that PUR is harmless is lacking [5, 6]. There is insufficient evidence for the long-term adverse effects of covert urinary retention; however, it is known that even a single episode of over-distension of urinary bladder can lead to long-lasting voiding difficulties, recurrent urinary tract infections, and impaired renal function [7, 8]. These effects could be reduced by timely management [9]. Recommendations by the Research Society of the International Consultation on Incontinence regarding the postpartum period are to first determine whether there is a need to assess for covert PUR and to determine long-term consequences of PUR [10]. We hypothesized that increased PVRVs might have an impact on the incidence of urinary tract infections and urinary incontinence. In this study, by identifying the risk factors for asymptomatic urinary retention and its consequences, we collect evidence to revise peripartum and postpartum bladder care management.

Materials and methods

We conducted a prospective observational study from February 2018 to October 2020, at the University Hospital in Bratislava, Slovakia. Ethical approval was obtained from the Institutional Ethical Review Committee, and the study was registered in the clinical trials register. All sui iuris women giving birth to singletons and willing to participate were included. Written informed consent was obtained from all parturients. All participants were nulliparous Slovak-speaking women with a living newborn. Those with symptomatic urinary retention after delivery—unable to void or with lower abdominal pain or a sense of fullness—were excluded secondarily. All participants underwent ultrasound determination of PVRV postpartum on day 3, the day of discharge from the maternity ward, after spontaneous micturition. Ultrasound determination of PVRV was conducted by the first author, and the volume was determined by measurement of three dimensions of the urinary bladder in two perpendicular planes (GE Ultrasound The Voluson™ S10). Data related to the delivery, pregnancy, mother, and child were collected and integrated with the ultrasound examination protocol. The cut-off value determining normal value was set by percentiles, owing to nonparametric data distribution. Volumes above the 90th percentile of residual urine were considered abnormal. Two-sample *t* test, Chi-squared, or Fisher's exact test were used to assess the potential relationships between abnormal PVRV on the 3rd day postpartum and each of the following obstetrical covariables: age, body mass index (BMI; before pregnancy and before delivery, weight gain), mode of delivery, range of tears (episiotomy; perineal, vaginal, or labial tears; or cervical rupture), infant's birth weight, duration of labor, use of epidural anesthesia, use of the Kristeller maneuver (reported by patients retrospectively as use of any pressure on the uterus), gestational week, induction of labor, and previous pregnancies. In addition, the ratio of the weight of the newborn (in grams) to the mother's height (in centimeters) was calculated. Difference in variances for every variable in group and control cases was tested using the F test of equality of variances.

Proven risk factors from the bivariate analysis were then analyzed in a linear regression model, combined with other influential variables. Using backward stepwise elimination, the linear regression model was reduced to significant variables, retaining very strong power.

All participants were invited to a second ultrasound determination of PVRV after 6 weeks. They were asked to complete a questionnaire about infections and medications during the puerperium, general health questionnaire SF36, as well as urinary Incontinence Quality of Life Scale (I-QOL) and King´s Health Questionnaire—urogynecological questionnaires concerning urinary incontinence and quality of life. The questionnaires were accessible online or in a printed version during the second appointment in the outpatient department. All data were digitalized, and the same groups were compared by incidence of urinary tract infections, urinary incontinence, and general quality of life. Score differences in all categories were compared using Kruskal–Wallis test. All data were analyzed using the statistical tools of Analysis ToolPak in Microsoft Excel (2016) and "R" software (v.4.1.0).

Results

A total of 1,012 women were asked to participate in the study: 86 refused to participate or were excluded secondarily, and 926 were included. All participants underwent ultrasound determination of PVRV; 526 women responded to the online questionnaires, and 434 returned for the second ultrasound examination (Fig. 1). According to the data distribution of the measured urinary volume, with the expected pathology on the single tail of the curve, the 90th percentile was determined as the cut-off value, corresponding to the volume of more than 100 ml of PVRV, which was therefore considered abnormal. Range of the retained volume was 0–670 ml; median 15 ml. Table 1 and a histogram (Fig. 2) show the number of patients at selected levels of PVRV. The group of women with abnormal residual volume (n=90)

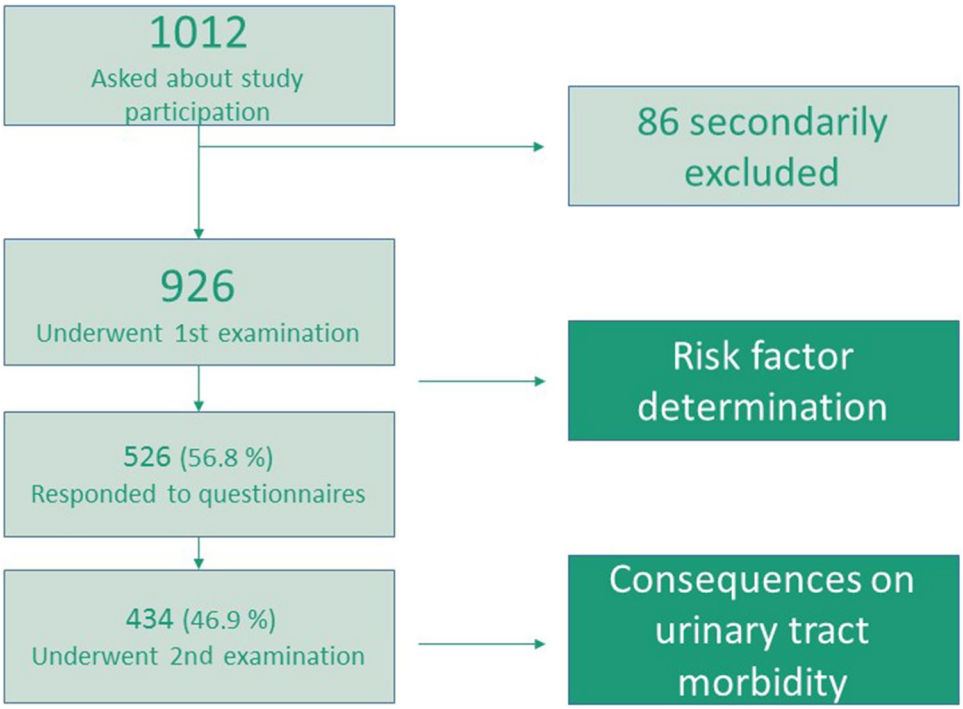

Fig. 1 Flow-chart: number of patients in the study

Table 1 Post-voiding residual volume (*PVRV*): number of patients at selected levels

PVRV (ml)	*N*	Percentage
Less than 25	577	62.3
26–100	259	280
101–250	73	7.9
251–500	16	1.7
More than 500	1	0.1
Total	926	100.0

were compared with the rest of the cohort (n=836). Interval variables, characterized by mean and standard deviation, and nominal (or binary) variables, characterized by count and percentages, are listed in Tables 2 and 3 respectively. The individual risk factors for covert PUR with their relative risks are shown in Table 4.

Significant differences between the case and control groups were found in the weight of the newborn (p=0.02), gestational week (p=0.02), and the ratio of the newborn's weight to the mother's height (p=0.01; Table 2).

From the nominal variables characterizing the study group, significant differences were found in the elective cesarean section ratio (1.1% vs 6.3%, p=0.044), the presence of a vaginal tear (42.2% vs 28.7%, p=0.008), macrosomic fetus (17.8.% vs 8.7%, p=0.006), and induction of labor (35.6% vs 23.3%, p=0.010). The relative risks of all these

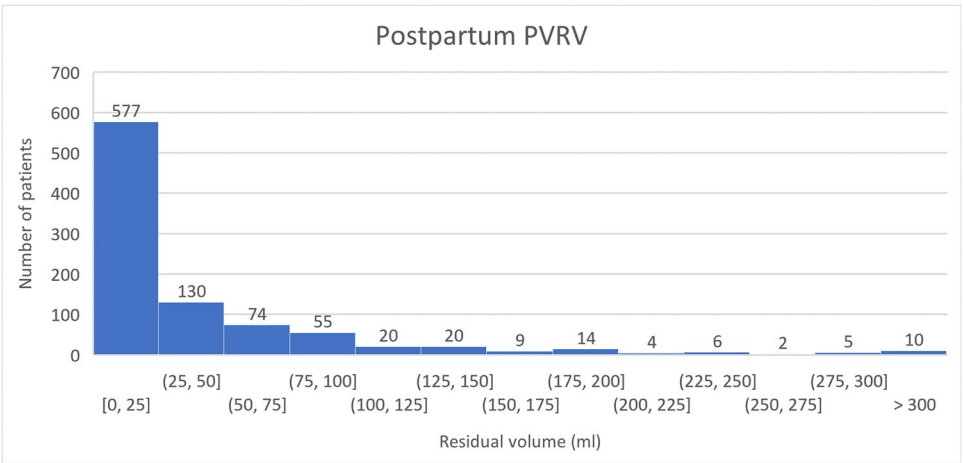

Fig. 2 Histogram: postpartum post-voiding residual volume (*PVRV*)

Table 2 Patient characteristics: interval variables

	Residual volume > 100 ml *n*=90	Residual volume < 100 ml *n*=836	*t*	*p* value
	Mean (SD)	Mean (SD)		
Age	30.22 (4.47)	30.45 (4.44)	−0.47	0.6393
Body mass index (kg/m^2)	27.91 (4.75)	27.74 (4.31)	0.34	0.7367
Weight gain (kg)	14.35 (5.47)	15.07 (5.31)	−1.20	0.2296
Height (cm)	167.73 (6.50)	168.20 (6.17)	−0.68	0.4953
First stage of labor (min)	467.76 (275.14)	434.64 (261.77)	1.08	0.2813
Second stage of labor (min)	22.95 (18.42)	26.67 (26.12)	1.65	0.1023
Newborn weight (g)	3,520.78 (454.11)	3,408.78 (443.29)	−2.28	0.0229 *
Gestational week	40.46 (1.19)	40.10 (1.36)	−2.40	0.0167 *
Natal weight to mother's height ratio (g/cm)	21.00 (2.57)	20.28 (2.62)	−2.48	0.0133 *

SD standard deviation, *t* result of two-sample *t* test

*$p < 0.05$

Table 3 Patient characteristics: nominal variables

	Residual volume > 100 ml *n*=90		Residual volume < 100 ml *n*=836		Chi-squared	*p* value
	Count (%)		Count (%)			
Primigravidae	75 (83.3)		708 (84.7)		0.11	0.7354
Vaginal delivery	70 (77.8)		621 (74.3)		0.52	0.4693
Cesarean section	8 (8.9)		139 (16.6)		3.64	0.0564
Acute	7 (7.8)	87.5%	86 (10.3)	61.9%	0.57	0.4520
Planned	1 (1.1)	12.5%	53 (6.3)	38.1%	4.04	0.0444 *
Vacuum extraction	9 (10.0)		62 (7.4)		0.77	0.3817
Forceps	3 (3.3)		14 (1.7)		F	0.2982
Instrumental delivery (together)	12 (13.3)		76 (9.1)		1.7	0.1927
Kristeller maneuver	31 (34.4)		230 (27.5)		1.93	0.1652
Epidural anesthesia	65 (72.2)		538 (64.4)		2.21	0.1370
Labor augmentation, oxytocin	37 (41.1)		327 (39.1)		0.14	0.7127
Cervical laceration	13 (14.4)		70 (8.4)		3.67	0.0555
Vaginal tear	38 (42.2)		240 (28.7)		7.06	0.0079 *
Episiotomy	43 (47.8)		332 (39.7)		2.19	0.1389
Front compartment laceration	13 (14.4)		195 (23.3)		3.67	0.0552
Perineal tear: combined	36 (40.0)		283 (33.9)		1.36	0.2445
Perineal tear: 3rd and 4th degree	4 (4.4)		42 (5.0)		F	0.8594
Induction of labor	32 (35.6)		195 (23.3)		6.56	0.0104 *
Newborn weight more than 4,000 g	16 (17.8)		73 (8.7)		7.65	0.0057 *

Fisher´s exact test was used in these cases

*$P < 0.05$

risk factors were determined to be more than 1.5. Elective cesarean section was confirmed as a protective factor, with p=0.04, but the 95% confidence interval exceeds 1; therefore, RR and OR cannot be considered significant (Table 4).

Several possible risk factors for urinary retention were included in the linear regression model. The mode of delivery, maternal characteristics (height, weight, and BMI), and the weight of the newborn were not confirmed as predictive factors for asymptomatic urinary retention. The only statistically significant predictors of the risk group were induction of labor (p=0.003), vaginal tear (p=0.032), and gestational week (p=0.043; Fig. 3).

In the second examination, covert PUR was no longer present, and the values of residual urine decreased for all

Table 4 Relative risks of confirmed risk/protective factors

	Odds ratio	Confidence interval: upper, lower	Risk ratio	Confidence interval: upper, lower
Newbornweight more than 4,000 g	**2.26**	1.25, 4.08	**2.03**	1.24, 3.33
Vaginal tear	**1.82**	1.16, 2.83	**1.70**	1.15, 2.53
Induction of labor	**1.81**	1.14, 2.87	**1.70**	1.13, 2.55
Planned cesarean section	0.17	0.02, 1.22	0.18	0.03, 1.28

Statistically significant relative risks are in bold

patients in the case group. Only 6 women in total (1.1%) reported a urinary tract infection. Any type of urinary incontinence was reported in 155 (29.2%) of cases. Table 5 shows the scores of all parts of the questionnaires, scores in different subcategories of the SF 36 questionnaire, and the comparison between groups using the Kruskal–Wallis test. There were no statistically significant differences between the groups.

Discussion

The ultrasound findings of urinary retention in asymptomatic women after delivery seems to be clinically nonsignificant. Six weeks after delivery, there were no differences between women with early postpartum abnormal PVRV and those without. They did not suffer more urinary tract infections (UTIs) or have more symptoms of urinary incontinence than the control group, and their perception of their health was comparable with that of the control group. Covert urinary retention after delivery seems to be a self-limited phenomenon, as previously concluded by some authors [1]; all volumes of remaining urine in the group of women with abnormal PVRV were lower after 6 weeks. Based on our results, the ultrasound screening for residual urine after delivery in asymptomatic women may be considered unnecessary.

Results in the context of what is known

Identification of risk factors for early PUR is precarious and dependent on the observed population and obstetric practice. The globally reported range of PUR incidence is wide because of different cut-off values used for covert PUR and different times of measurement. There is no agreement in the literature on the cut-off value of PVRV defining covert PUR: values of 100, 150, and 250 ml are used, with 150 ml being the most common. This value would facilitate comparison with other studies; however, it is a value set arbitrarily referred to as the normal upper limit of post-void residual bladder volume and a commonly used criterion in clinical practice [3]. Nevertheless, its utilization in clinical practice means that it is used in post-surgery management in older patients, primarily after surgery for incontinence or pelvic organ prolapse. Some researchers suggest changing the definition of covert PUR to "PVRV of more than 500 ml after first spontaneous void after delivery," because with criteria of 150 ml after first voiding, up to 47% of women were diagnosed with covert PUR [11].

In healthy adults, bladder emptying is considered adequate if less than 50 ml of urine remains after voiding, and less than 30 ml is considered insignificant [12]. Some authors use a value of 100 ml, but it is arbitrarily selected [2]. Our cut-off was also 100 ml, and it was set by percentiles (10%) owing to the data distribution of residual urine in our population. Another challenge when comparing studies of PUR is the different time of measurement. In the study of Yip et al., the ultrasound examination was realized the first morning after the labor; this could be from a few hours to almost 24 h after the labor [3]. Other studies performed the measurements after the first postpartum voiding [13, 14], 4 h after labor [15], or 6–8 h after labor [1]. French authors who used values of more than 100 ml and measured the PVRV on the 3rd day postpartum, the same as in our study, found an incidence of covert PUR of more than 36%, but did not find any significant risk factors [2]. One recent study concerning PUR was conducted by Kawasoe and Kataoka [1]. Comparison of their results with ours is difficult because major differences in basic characteristics (duration of labor, birth weight, and ratio of operational vaginal deliveries) and in methodology (different time of measurement and cut-off values) exist. They found incidence of covert urinary retention of only 0.28%. However, our findings are consistent with their findings: they found that more than half of the patients recovered spontaneously on day 2 or 3 and 16 out of 18 women within 6–10 days postpartum [1].

One of the largest studies concerning this subject found that primiparity and large perineal tears, as well as cesarean section, are independent predictors [15]. Other authors add prolonged first or second phase of labor [14], use of epidural analgesia, episiotomy and macrosomic fetus [13] as risk factors for urinary retention. Although several authors have shown that PVRV often normalizes spontaneously [3, 16, 17], data on

Linear Regression Results

	Dependent variable:
	risk_100
Age	-0.0003
	(-0.005, 0.005)
Mother's Height	-0.002
	(-0.006, 0.001)
Natal Weight	0.00002
	(-0.00004, 0.0001)
BMI	-0.004
	(-0.010, 0.001)
Gestational Week	0.024**
	(0.004, 0.043)
Induction	0.096***
	(0.043, 0.150)
Perineal Tear	0.024*
	(0.0003, 0.047)
Kristeller	0.026
	(-0.020, 0.072)
Vaginal Tear	0.060**
	(0.014, 0.105)
Constant	-0.470
	(-1.465, 0.525)
Observations	485
R^2	0.064
Adjusted R^2	0.047
Residual Std. Error	0.292 (df = 475)
F Statistic	3.630*** (df = 9; 475)
Note:	*p<0.1; **p<0.05; ***p<0.01

Fig. 3 Linear regression results; coefficients of variables included in the linear regression model with confidence intervals in parentheses. R^2 coefficient of determination

long-term and adverse effects were still lacking. One of a few such studies by Yip et al. concentrated on the overt form and could not prove an increased incidence of urinary incontinence, frequency, nocturia, or urgency in a 4-year follow-up study of women with symptomatic PUR [18].

Table 5 Results of the Kruskal–Wallis test, comparing questionnaire scores in the risk and control groups

Questionnaires, categories	Kruskal–Wallis test	
	Chi-squared	*p* value
Physical activity	11.65	0.3090
Physical role limitations	11.61	0.7703
Emotional role limitations	10.58	0.3054
General health	13.26	0.5058
Pain	15.93	0.5289
Energy/fatigue	9.50	0.8501
Social activity	6.94	0.5437
Emotional health	15.33	0.4278
IQoL	30.11	0.8951
Incontinence: subjectively	2.56	0.9587
KHQ: part one	9.74	0.7153
KHQ: part two	90.34	0.5294

IQoL Incontinence and Quality of Life, *KHQ* King´s Health Questionnaire

Clinical implications

The risk factors determined by our study contribute to physiological changes following pregnancy and increase the probability of PUR. Mechanical trauma from instrumental delivery can lead to aggravated perineal edema, which restrains bladder voiding. Pudendal nerve damage occurring during instrumental deliveries can impose afferent innervation of the urinary bladder and obstruct reflex relaxation of pelvic floor muscles and urethral sphincter [19]. This nerve damage is generally temporary and unlikely to cause chronic retention.

However, our results from the puerperium suggest that postpartum ultrasound examination of urinary bladder in asymptomatic patients may be redundant. If the patient does not report voiding difficulties, the remaining volume in the urinary bladder does not seem to be relevant for clinical practice. With the knowledge of no additional difficulties of incontinence or infections in women with residual urine compared with those without, we could discuss elimination of the postpartum ultrasound screening from everyday practice. Clinical attention should be directed at women with urinary symptoms. Prolonged pregnancy, as a risk factor of urinary retention proven by this study, could contribute to the continuation of the discussion about induction of labor, even in low-risk term pregnancies. Even if not changing perinatal results dramatically, it lowers the proportion of cesarean sections [20, 21]. Thus, induction of labor could be performed not only because of fetal but also because of this maternal indication.

Research implications

Further questions emerge from this research, primarily the involvement of pain in the genesis of covert urinary retention. Several studies suggest that episiotomy as a risk factor for retention might exert its effects through pain [13, 22]. Pain (from surgical suture) causes interference directly in sensations from the urinary bladder but also via the central inhibition of urinary bladder function [13]. In our study, pain seems to relate to abnormal PVRV, but the relationship is not statistically significant. An approach using specific pain-related questionnaires could uncover these connections. Other variables for future research are the Kristeller maneuver and BMI. When compared with a linear regression model without the Kristeller maneuver and BMI, the model was weaker. This suggests that the Kristeller maneuver and BMI, although not significant predictors of risk themselves, have a qualitative effect on the risk. This may be because they are confounding variables, or they may be related to significant factors that were not studied in the current research.

Strengths and limitations

To the best of our knowledge, this study is the first to report vaginal tear as a risk factor for covert PUR. Previous studies did not differentiate between different tears and considered only high-degree perineal tears and episiotomy [23, 24]. Vaginal tear is in near anatomical proximity to the urinary bladder and urethra; therefore, the edema and pain can directly interfere with them. With the surgical suture, the anatomical relations between these structures can be directly influenced. Avulsion of the levator muscle is common with high-degree vaginal tear and disrupts the statics of the pelvic floor, influencing the urinary bladder. In addition, a recent large study exploring different tears in labor reported a connection between vaginal tearing and a personal or family history of insufficiency of the connective tissues, which could also be a cause of the inability of the bladder to empty adequately [25].

Induction of labor is confounded with post-term pregnancy; 40% of indications for induction in our cohort were for post-term pregnancies, and prolonged pregnancy was also determined to be a risk factor.

Although this study was conducted with data on PVRV after delivery from over 900 women, it has some limitations. First, the responsiveness of patients in the late part of the study was lower than expected, also because of COVID-19-related mobility restrictions; less than 50% participated in the second examination.

Second, some inaccuracy between retained volume and its ultrasound measurement is always present, especially in very low and high volumes [26]. Volumes close to 0 ml are impossible to calculate precisely using ultrasound, owing to the irregular shape of the bladder when almost empty. In contrast, retention of large volumes can also make ultrasound determination less accurate because of the impossibility of containing the entire bladder on one image [27]. These patients, who usually perceive pain and are unable to void, were excluded from our study. The main reasons for the use of ultrasound were that it is non-invasive, comfortable, painless, quick, and safe.

Some other limitations that should be acknowledged are the low incidence of the outcome measure of UTI in the assessment after 6 weeks. The study may thus be underpowered to establish an association. Furthermore, the sole use of subjective measures in the 6-week assessment predisposes to recall and measurement bias. Careful conclusion statements about 6-week morbidity need to be presented because not all potential morbidities of voiding dysfunction—overactive bladder syndromes, urinary retention, or impaired renal function—were studied.

Finally, the use of the above-mentioned, generally accepted definition of covert retention as a volume of more than 150 ml would facilitate comparison with other studies, but, given the results after the puerperium, it seems redundant.

Conclusions

Normal and abnormal values of PVRV postpartum were determined in this study, and vaginal tear, gestational week, and induction of labor were proved to be risk factors. Women included in the study were observed after 6 weeks postpartum. The incidence of asymptomatic retention was null. Moreover, there were no differences in the incidences of UTIs and urinary incontinence in the groups of women with and without abnormal PVRV postpartum. To conclude, abnormal volumes of urine retained during the early postpartum period seem to have no consequences for urinary tract morbidity during the puerperium, and it is a phenomenon with self-correction tendencies. Our findings suggest that clinical attention should be directed toward women with symptomatic retention and not toward those with only ultrasound findings of retained urine.

Author contributions P. Dolezal: methodology, investigation, formal analysis, writing the original draft; M. Ostatnikova: writing the original draft, writing (review and editing); B. Balazovjechova: writing (review and editing), visualization; P. Psenkova: investigation, data curation; J. Zahumensky: conceptualization, methodology, supervision.

Declarations

Conflicts of interest None.

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