Pregnancy, vaginal delivery, oxytocin and prostaglandin for induction of labour, instrumental vaginal delivery (forceps, VE) and type of anaesthesia and its factual impact on anatomy and function of pelvic floor

Krzysztof Czajkowski1, Magdalena Bros-Konopielko1, Justyna Teliga-Czajkowska2

Abstract
Urinary incontinence of different type and degree quite often occur during pregnancy. Physiological changes in hormones, dynamic force during second stage of delivery as well as post-delivery anatomical defects are the factors which contribute most to the impairment of pelvic floor. The authors review the impact of the number of pregnancies, delivery mode, childbirth-related pelvic floor injury and the BMI of the patient on the occurrence of UI in different stages of life. The evolution of UI symptoms during lifetime is being discussed. Pelvic floor muscle exercise (PFME) for the increased strength of the pelvic floor and paraurethral muscles are suggested as a preventive maintenance.

Key words: urinary incontinence, pregnancy, vaginal delivery

Introduction
Urinary incontinence (UI) is defined by International Continence Society (ICS) as the complaint of any involuntary loss of urine [2]. During the pregnancy many women can experienced urinary incontinence of different type and degree. Pregnancy itself is an important factor affecting pelvic floor function. Physiological changes in hormones, dynamic force during second stage of delivery which effects levator ani as well as post-delivery anatomical defects are the factors which contribute most to the impairment of pelvic floor. The connective tissue is subject to change during pregnancy throughout the body. The main reason for this change is to adopt uterine capacity to pregnancy volume and prepare the pelvic gird, vagina and pelvic floor for vaginal delivery. The adaptation of connective tissue to the challenges of gestation and labour results in changes of the urethrovesical angle. Side effect include different pelvic floor disorders leading to urinary incontinence and destabilisation of pelvic floor connective tissue. Progesterone may promote relaxation of bladder and ureters’ smooth muscles. There is physiological increase in glomerular filtration, urinary output and dilation of the upper urinary tracts. The growth of renal glomerular filtration rate and urine output leads to increased voiding and nycturia which both appear in the first weeks of pregnancy mounting up with each trimester. Together with enlargement of uterus, indention of bladder dome is progressing and frequency of voiding increases. Pregnancy is associated with an increased mobility and descent of the bladder and other pelvic organs. The support of the anterior vaginal wall and bladder is getting weaker. Occurrence of asymptomatic descent of the anterior vaginal wall and bladder by the third trimester of pregnancy can be regarded as a norm. In the end of pregnancy, bladder is permanently squeezed by uterus and about 200 ml of urine remain un ureters. Functional urethral length, maximal urethral pressure and closure pressure increase during pregnancy. Few studies have linked vaginal delivery to injury of the pudendal nerve.

Before first pregnancy
Pelvic floor dysfunctions are one of the most important problems affecting health and social life. Before the first pregnancy about 5% of women complained from pelvic floor disorders and 13.5% of primiparas had urinary incontinence before pregnancy [18]. Over a lifetime one third of the female population will suffer from pelvic floor disorders with different severity and symptoms [28]. Analysing data according to the influence of pregnancy on pelvic floor disorders, it should be taken into account that sometimes those disorders can be present before pregnancy. In a group of 969 nulliparous women

1 II Department and Clinic of Obstetrics & Gynaecology, Medical University of Warsaw, Poland
2 Department of Obstetrics and Gynaecology Didactics, Medical University of Warsaw, Poland
with mean age 31.8 years, any urinary incontinence occurred in 27.7%. Only 54% of sufferers were bothered with this situation. SUI (stress urinary incontinence) in any form was present in 19.7% of all nulliparas (9.8% – on significant level), UUI (urge urinary incontinence) in any form was present in 14.9% and on significant level in 5.3% of women before their first pregnancy [14]. In the other group of women, childhood enuresis and previous history of urinary incontinence were significantly associated with urinary incontinence later in life [1].

Urinary and anal incontinence before pregnancy were significant factors increasing the risk for postpartum incontinence [18].

Number of pregnancies

Number of pregnancies had a significant influence on the risk of urinary incontinence – SUI showed 8.2% of primiparas and 20% multiparas; UI was present in 5.5% of primiparas and in 13% of multiparas [42]. 46.6% of multiparas link the onset of urinary incontinence with delivery [53].

One can say, that first pregnancy until the first delivery has no impact on the pelvic floor disorders. Urinary incontinence (UI) is defined by International Continence Society (ICS) as the complaint of any involuntary loss of urine [2]. During the pregnancy, many women can experience different kind of urinary incontinence to some degree. Abdullah and colleagues [1] in the group of 306 primigravids observed urinary incontinence during third trimester in 34.3% of woman. The commonest form of UI was stress incontinence (64.8%), next mixed incontinence (24.8%) and urge incontinence (6.7%). Daugherty and colleagues [14] in a group of 189 patients (mean age 35.0 years) after one vaginal delivery reported some urinary incontinence in 43.9%, stress incontinence in 37.6% and urgent incontinence in 12.7%. In case of the multiparas (mean age 41.1 years) authors observed incontinence in 46.2%, 40.4% and 16.5% respectively. Other investigation showed results of special questionnaire which was carried twice: in the third trimester of pregnancy and in the postpartum period [61]. The results were as follows: more often urinary distress symptoms (41.8% versus 15.8%), problems with pelvic organ prolapse distress (29% versus 12.8%), colorectal anal distress; (24.2% versus 20.7%) occurred postpartum.

Bros-Konopielko et all [12] checked the occurrence of urinary incontinence among 250 women during pregnancy and in early stage of puerperium. The questionnaires with questions concerning urinary incontinence, were given to women 1-5 days after the delivery. The results showed that the prevalence of urinary incontinence in pregnancy, childbirth or in the early postpartum period, was high. 54% of analysed women experienced urinary incontinence. 56% of surveyed women declared stress, 28% mixed and 16% urge urinary incontinence during gestation and puerperium. 20% of incontinent women declared that urinary incontinence had started before pregnancy. 15% of surveyed women had urinary incontinence only in the course of pregnancy. 10% of surveyed incontinent women declared postnatal urinary incontinence.

Lewicky-Gaupp and colleagues [32] presented prospective cohort study on a group of teenagers in the first pregnancy. In the third trimester of pregnancy urinary urge incontinence was present in 55% of women, urinary stress incontinence – in 69%, faecal incontinence – in 16%, and flatal incontinence – in half of them. Most of the observed symptoms were less frequent 6 weeks postpartum – urinary urge incontinence 9%, urinary stress incontinence 5%, faecal incontinence 4%, flatal incontinence 9%. In Poland, the average age of women at first pregnancy is about 29 years. This may also affect the number of incontinent patients. In young women six weeks postpartum after normal spontaneous delivery or operative vaginal delivery, urinary and anal symptoms are on the same level, with the exception of flatal incontinence which is statistically more often after operative vaginal delivery - 27% versus 3% [32]. Younger age may protect the pelvic floor in the immediate postpartum period, irrespectively of the delivery mode and additional risk factors [32]. Six weeks after vaginal delivery, urinary and anal incontinence rates were lower in teenagers than in other groups of patients.

Other authors investigated the prevalence of urinary incontinence among primigravida in the third trimester [1]. The prevalence of urinary incontinence during third trimester was 34.3%. Stress incontinence (64.8%) was the most common, followed by mixed incontinence (24.8%) and urge incontinence (6.7%) [1].

Persson and colleagues [45] analysed a group of 10 074 women who underwent a surgery for stress urinary Incontinence. The authors concluded that vaginal delivery had been strongly associated with a need of surgery for stress incontinence in the future. The risk was increasing with the parity – from OR = 3.57 after one delivery to OR = 7.14 after more than 3 deliveries. An important factor also was increased age at the first delivery, but not at the last one [46].
Evolution of symptoms

There are only few systematic data on the evolution of urinary symptoms during pregnancy and after delivery. One of the most interesting analyses of pelvic floor dysfunctions related to pregnancy was published by Stanton and colleagues [55]. They showed evolution of urinary symptoms starting the observations before the first pregnancy. In primigravid women, frequency of the urinary symptoms at the time of the first prenatal visit (as compared to prepregnancy) was doubled (49% versus 25%) and then was increasing slowly to the 92% in the third trimester. After delivery frequency of the urinary symptoms decreased to 22%. The next symptom – nocturia – before pregnancy was present in 4% of women, at the time of first prenatal visit – in 19%, in the third trimester – in 72% and after delivery – in 6% of women. Urinary stress incontinence was less frequent – none before pregnancy and respectively in 6%, than 34% and 6% of cases postnatally. In a group of 1128 pregnant women, prevalence of UI increased during pregnancy, from 9.2% in the first trimester to 34.6% in the end of pregnancy [17]. Light, moderate and severe urinary incontinence was present in 66%, 32% and 2% of all women respectively with UI symptoms in the first trimester. In the third trimester, UI symptoms occurred in 52%, 44% and 4% of women respectively. Episodes of incontinence were related to the cough or sneeze (68% in the first trimester and 80% in the third trimester) and exertion (16% in 1 trimester and 19% in 3 trimester).

Yang and colleagues [60] compared urinary incontinence and its severity prepregnancy, during pregnancy, 4 days, 42 days and 6 months after delivery. Significant differences were noted between mentioned subgroups. Generally SUI and UUI were more frequent in the end of puerperium than in other periods. O’Boyle and colleagues [40] evaluated POPQ in 172 pregnant women. In the first trimester, the stage 0 occurred in 15.5% of cases, stage 1 – in 94.6% and stage 2 – in 1.2% of pregnant women whereas in the third trimester in 1.9%, 63.5% and 35% respectively. This data confirmed the impact of pregnancy on pelvic floor stability. Post-delivery, none of the patients were in stage 0 POPQ, 65% of women had POPQ stage 1 and 35.5% – stage 2 [41].

Mode of delivery

Mode of delivery has an impact on the urinary incontinence, at least in 6 months after delivery [60]. The prevalence of urinary incontinence was nearly 4 times higher after vaginal delivery than after caesarean section (16.6% versus 4.3%). Differences were present in frequency of stress urinary incontinence (13.5% versus 3.5%), urgent urinary incontinence (1.8% versus 0.6%) and mixed urinary incontinence (1.4% versus 0.2%). Among 198 women 10 to 14 months after their first delivery, 64% had at least one symptom of pelvic floor dysfunction and approximately half of them reported pain or discomfort in sexual relations [34]. In this group, urinary stress incontinence occurred in 12.1% of cases and urge incontinence – in 9.1%. Nearly 60% of affected women reported these disorders as bothering. Faecal or flatus incontinence were present in 10% of women – 85% of them defined those problems as bothering. Women who underwent delivery with perineal suture or vacuum-assisted delivery reported more often dyspareunia and slightly often (not significantly) – stress urinary incontinence.

Disorders occurring during pregnancy represent important risk factors for the future. If incontinence appear in pregnancy, risk for UI (OR = 4.6) as well as for anal incontinence (OR = 3.6) after delivery is accrued [57].

Compared with spontaneous vaginal delivery, forceps delivery increased the risk of urge urinary incontinence (OR = 1.5 – 2.1) in the first 6 ÷ 7 month postpartum [13, 18] but presumably, had no influence on stress urinary incontinence. Forceps delivery doubled the risk of anal incontinence compared to spontaneous vaginal delivery, probably due to increased risk of levator ani injury (OR = 3.4 – 14.7) [15, 27, 46]. Significant correlation was found between operative vaginal delivery and future dysuria (OR = 3.14) or voiding frequency (OR = 4.28) [42]. Urinary symptoms at 6 weeks after instrumental vaginal delivery (forceps, ventouse, both of them) were: increased frequency of voiding (20.4%), urinary leakage (16.2%) and difficulty in holding on urine (9.6%) [33]. One year after instrumental delivery symptoms mentioned above were present in 28.6%, 17% and 12.9% which confirmed permanent impact of instrumental delivery on pelvic floor function. In other research vacuum delivery did not cause more urinary incontinence and pelvic floor dysfunctions than spontaneous vaginal delivery [44].

De novo impaired urinary continence observed six month after pregnancy was related to a greater gestational weight gain and bearing-down effort longer than one hour [4]. Two years postpartum, persistent SUI since pregnancy, reported 9.5% of women [5]. The only factor found to be associated with persistent SUI was higher body mass index (OR = 1.19).
Other factors

Miller et al. [38] describe occurrence, recovery, and consequences of musculoskeletal (MSK) injuries in women at risk for childbirth-related pelvic floor injury at first vaginal birth. The injuries were evaluated by MSK magnetic resonance imaging at 7 weeks and 8 months' postpartum. Their study had shown that the bony abnormalities, like bone marrow edema and pubic bone fracture, resolve 8 months postpartum. This did not apply for levator ani (LA) muscle injury which resulted in levator weakness and posterior-vaginal wall descent. These musculoskeletal injuries were not correlated with urethral pressure, volume of demonstrable stress incontinence, or self-reported incontinence severity [16].

Intact perineum during delivery is a protective factor for urinary incontinence (OR = 0.51) as well as for anal incontinence (OR = 0.41) [57]. Bo et al. [8] compared pelvic floor muscle and prevalence of urinary incontinence at 6 weeks postpartum, in two groups of women: with and without lateral or mediolateral episiotomy. The episiotomy was performed for indications such as foetal distress or imminent risk of severe perineal tear. The authors concluded that PFM function and/or prevalence of postpartum UI, were not affected by a lateral or mediolateral episiotomy [8]. Serati et al. [52] evaluated the role of the maternal position (upright or supine) at the time of delivery on the onset of de novo symptoms of urinary incontinence in the postpartum period. Women from the upright position group during labour, had a significantly lower rate of de novo urinary incontinence (40.5% vs 48.9%, p = 0.03) and in particular – of stress urinary incontinence. They had a significantly lower episiotomy rate, but a higher rate of more serious, than second degree perineal tear. Mediolateral episiotomy in the multifactorial analysis had a protective impact on the risk for later stress urinary incontinence surgery (OR = 1.41) [46]. On the other hands, Yohai et al. [61] showed that stress urinary incontinence was significantly associated with spontaneous perineal tear at delivery. In other research, the presence of episiotomy and birth weight, were not significantly associated with any of the pelvic floor disorders items.

Urinary incontinence was associated with induction of labour with prostaglandins (OR = 1.74) [42]. In the multifactorial analysis, epidural analgesia during delivery was also a significant factor for later stress urinary incontinence surgery (OR = 0.82) [46].

Pregnancy and delivery are essential for pelvic floor disorders but there are some important factors which alters urinary and anal continence regardless of pregnancy [57]. Among important prognostic factors of urinary incontinence unrelated to pregnancy are: incontinence before pregnancy (OR = 8.1), chronic cough (OR = 3.03) family history of UI (OR = 2.56), constipation (OR = 1.70) and age > 35 (OR = 1.60). Anal incontinence is present significantly more often in case of women with incontinence before pregnancy (OR = 4.3) and the family history of anal incontinence (OR = 2.38).

Increased BMI is a risk factor for incontinence in nonpregnant women [9, 37]. Mean BMI in young pregnant women did not differ significantly between groups with and without incontinence [32], but some authors believe that in older pregnant women the pelvic floor problems can be related to an excessive gestational weight gain or obesity [19].

Study of Abdullah et al. [1] showed that more than 50 percent of women with urinary incontinence in the third trimester felt that it did not affect their daily activities at all and only 10% of women felt greatly affected by this problem. It is very important to prevent a urinary incontinence after delivery, as Fritel’s et al. [22] study has shown. In this study de novo urinary incontinence (even mild form) in the postpartum period was associated with depressive symptoms or antidepressant drug consumption.

Dyspareunia is an oppressive problem for many women. No significant associations were found between dyspareunia and labour induction, use of epidural anaesthesia during labour, duration of second stage, episiotomy, perineal tear, birthweight and lactation [51].

Drop of vagina

In whole population of women, important factors for appearance of future symptomatic POP are: any vaginal rupture or episiotomy (OR = 1.7), more than one delivery (OR = 1.6 – 3.1) and age > 50 years [56]. Anal incontinence was increased in women who received oxytocin, had an episiotomy or delivered macrosomic infant [13]. Six weeks after vaginal delivery urinary and anal incontinence rates were lower in teenagers than in other patients groups where urinary incontinence rates reached as high as 31%, fecal incontinence – 11% in women without an anal sphincter tear and 27% – in women with a sphincter tear [10, 35, 48]. The occurrence of prolapse (POPQ s ≥ 2) within 6 months’ postpartum varies from 18% to 56% [29]. If the stress incontinence had not re-mitted by three months postpartum, the presence of symptoms five years afterward reached 92% [59].

In the group of old women after multiple deliveries, 10% had fecal incontinence and 25.2% – flatal inconti-
cence [23]. The major risk for fecal incontinence was advancing age. The risk factor for flatal incontinence were more than three deliveries.

**Preventive maintenance**

Pelvic floor muscle exercise (PFME) is used to increase the strength of the Pelvic Floor Muscle (PFM) and paraurethral muscles. That leads to improvement of the efficiency of the supportive function by the urethra immobilization and improvement of the sphincter function by increase of the intraurethral closure pressure during physical activities [6, 50]. PFME is considered the first-line intervention for prevention and treatment of stress urinary incontinence during and after pregnancy ahead of other therapies [21].

The PFME should even start during pregnancy. Norwegian randomized controlled trial of 855 pregnant women indicates that pregnant women should exercise pelvic floor muscle during pregnancy, to prevent and treat urinary incontinence in late pregnancy [54]. In that study, exercises were performed for 12 weeks (conducted between 20 and 36 weeks of gestation). One weekly group session was led by physiotherapists, and home exercises were encouraged at least twice a week. Controls received regular antenatal care. The result showed that fewer women in the intervention group reported any weekly urinary incontinence (11 versus 19%, \( P = 0.004 \)). Another two randomized controlled trials of Peleaž [43] and Sangswang [50] showed that pelvic floor muscle training in pregnancy prevented urinary incontinence in late pregnancy and after the delivery. In a large group of patients, Mason and colleagues [36] showed that women who performed the exercises several times per week, were significantly less likely to report stress incontinence in the postpartum period compared to women who exercised occasionally.

The National Institute of Clinical Excellence (NICE) also recommends PFME for all women in their first pregnancy for the prevention of SUI [39]. However only 28% of analysed Polish women performed pelvic floor muscle exercises postpartum and 33% of them felt improvement [12].

**Delivery after SUI operation**

Adams-Piper et al. [3] checked twenty-six patients who delivered a singleton pregnancy after the placement of midurethral sling (MUS): 16 patients had a retropubic MUS, and 10 had a transobturator MUS before the pregnancy. 14 patients delivered for the first time after MUS by cesarean section (CS). Of these, 5 CS were elective primary for the indication of previous MUS, 5 were elective repeated CS, and the remaining 4 – were for fetal indications. 11 patients had spontaneous vaginal deliveries. There were no MUS-related pregnancy complications. One patient from the CS group developed recurrent stress urinary incontinence postpartum. The vaginal route of delivery had no negative impact on urinary incontinence. The percentage of continent women before and after vaginal delivery was the same (91%). The percentage of continent women before and after CS was lower (79 vs 71%) [3].

**Conclusions**

Is it possible to improve pelvic floor function after pregnancy and delivery? Lavy and colleagues [30] suggested that nulliparous women should plan only one child. In order to obviate intrapartum trauma of the pelvic floor and the increased risk of subsequent disorders, obstetrician should advise an elective caesarean section. If somebody suggests, that caesarean section helps to prevent urinary incontinence, we should remember that it is valid until menopause and only then if there are no successive pregnancies. What was the real impact of number of pregnancies and deliveries on the future urinary incontinence was proven in paper published by Hsieh and colleagues [25]. In postmenopausal women, there was no association between urinary incontinence and parity or mode of delivery, even in women after more than 4 or 6 pregnancies, or those who never delivered. In the large Norwegian study 15 307 women were verified for presence and severity of any urinary incontinence – 10.1% of nulliparous women complained of urinary incontinence [49]. Among them, were 21% who had vaginal delivery and 15.9%, 6 who delivered by caesarean section. The protective effect of caesarean section attenuated with increasing age: in the age of 50–30% of women with previous vaginal deliveries and 28.6% of women with previous caesarean section had urinary incontinence. In other study, authors found similar rates of faecal incontinence in the group of women at the age of 50 between nulliparous (11.3%), primiparas (9%), and multiparous (10.4%) women [20].

There is some evidence that prophylactic pelvic floor muscle training in women who are having their first baby can prevent urinary and faecal incontinence in late pregnancy and in the postpartum period [7, 11, 24, 26, 31, 47, 58].
References


Krzysztof Czajkowski
II Department and Clinic of Obstetrics & Gynaecology
Medical University of Warsaw
00-315 Warszawa, Karowa 2 Poland