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Original Article

Effects of pushing techniques during the second stage of labor: A randomized controlled trial

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ABSTRACT

Objective: Spontaneous pushing is a method that is used in the management of the second stage of labor and suggested to be more physiological for the mother and infant. The present study aims to evaluate the effects of pushing techniques on the mother and newborn.

Materials and methods: This randomized prospective study was performed between June 2013–March 2014 in a tertiary maternity clinic in Istanbul. 80 low risk, nulliparous cases were randomized to pushing groups. Valsalva pushing group was told to hold their breath while pushing. No visual-verbal instructions were given to spontaneous pushing group and they were encouraged to push without preventing respiration. Demographic data, second stage period, perineal laceration rates, fetal heart rate patterns, presence of meconium stained amniotic liquid, newborn APGAR scores, POP-Q examination and Q-tip test results were evaluated in these cases.

Results: The second stage of labor was significantly longer with spontaneous pushing. Decrease in Hb levels in valsalva pushing group was determined to be higher than spontaneous pushing group. An increased urethral mobility was observed in valsalva pushing group.

Conclusions: Although the duration of the second stage of labor was longer compared to valsalva pushing technique, women were able to give birth without requiring any verbal or visual instruction, without exceeding the limit value of two hours and without affecting fetal wellness and neonatal results.

Introduction

The second stage of labor is the time period from full dilatation of the cervix (10 cm) up to the birth of the singleton baby or the last baby in a multiple pregnancy. Second stage is characterized with frequent and regular contractions in which the woman frequently feels vaginal-rectal pressure and extreme pushing urge. During the second stage, maternal pushing efforts promote the descent of the fetus in pelvis and the completion of cardinal movements. Pushing behavior of women in the second stage is generally classified as spontaneous pushing and valsalva-type pushing. Valsalva-type pushing contains strong and repeated pushing efforts continued for 10 s with closed glottis (by holding the breath), while spontaneous pushing technique includes breathing with open glottis and that the number of pushing efforts and the duration are determined by the urges of the woman's body.

Strong pushing started at the very beginning of the second stage caused some concerns about exhaustion and discomfort due to the same lithotomy position for the mother and unsuitable use of abdominal muscles. There were also concerns about perineum and genito-urinary path damages due to fast and strong descent of fetal head [1–4]. Despite these concerns, this early and strong pushing method has still been commonly used especially in Turkey.

Investigators started to compare the results of these two different pushing techniques over the last decades. Many studies have shown that valsalva-type pushing did not improve maternal and fetal results in the second stage [5–9] and that the results were better when woman's spontaneous pushing was allowed [2,4,6,10–16].

The purpose of our study is to compare the maternal/fetal/newborn results of valsalva method that is still commonly used worldwide and in Turkey, with those of spontaneous pushing method in which pushing is mainly managed by the woman's own urges.

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Table 1
Eligibility criteria for participants.

Inclusion criteria	*Exclusion criteria*
• Nulliparous • Aged range: 18-40 • Gestation week: 38-40 • Expecting vaginal delivery • Cephalic presentation • Single, healthy fetus • First stage of labor • Estimated fetal weight 2500–4000 gr	• Not volunteering for participation • Any medical or obstetric complication affecting second stage management • Administered epidural analgesics • Inability to comply with the group norms • Participants who did not attend follow-up visits

Materials and methods

This randomized prospective study was performed between June 2013–March 2014 in a tertiary maternity clinic in Istanbul. Written ethics committee approval for the study was obtained from Ethics Committee of the hospital. The study was carried out by randomized trial including a study group (spontaneous pushing group) and compared with a control group (valsalva pushing group). Principal investigator is a midwife in an university. Secondary investigator is a lecturer in another University in Istanbul.

The purpose of this study was to evaluate the effects of valsalva and spontaneous pushing techniques used by midwifes and obstetricians during the second stage of labor on the maternal and fetal/neonate outcomes. Study objectives were:

Primary: To compare the duration of the second stage of labor between the different pushing techniques.

Secondary: To compare the fetal (electronic fetal moniterization, meconium stained amniotic fluid rates), neonatal (Apgar scores, newborn resuscitation and intensive care requirement rates) and maternal outcomes (perineal and cervical laceration rates, average amount of blood loss, pelvic-perineal pain scores, POP-Q examination results, Q-tip test scores).

Eligibility criteria for participants are presented in Table 1.

Women randomised to the valsalva pushing group were coached by the investigator to use closed-glottis pushing three to four times during each contraction immediately when cervical dilation reached 10 cm and to continue pushing using this method with each contraction until birth. The investigator counted to 10 during each pushing effort to assist the woman in holding her breath for at least 10 s. Women randomised to the spontaneous pushing group were assessed as having full dilatation of the cervix, the investigator providing care suggested they commenced pushing only when they felt the urge to do so and gave no specific instructions about the timing of pushing, duration of pushing and their positions. Pushing instructions applied to groups and outcomes of the study are presented in Tables 2 and 3 respectively.

Statistical power analysis was used to calculate the required sample size. A pilot study of 20 subjects revealed that the means and standard deviations (SD) of the length of the second stage of labor for study groups were 53.4 (SD 25.2) and 35.3 (SD 30.1) respectively. Given a true difference in the length of the second stage of labor of 18.1 between study and control groups, and statistical power of 0.8 to reject a null effect at the 0.05 significant level, it was calculated that 38 subjects would be needed for each of the study and control groups. During the study period, 1614 births took place in the hospital and the cases giving birth when the main investigator was in the hospital were examined. Cases not suitable for study criteria and did not volunteer were excluded from the study. Investigation was completed with 80 cases (Fig. 1).

Women in labor were randomized to control group (valsalva pushing) and study group (spontaneous pushing). Randomization was accomplished by computer and individual envelopes with the randomization results kept in sealed outer envelopes in the delivery ward.

Women fulfilling the inclusion criteria were informed about the study. Volunteering women gave written and verbal consent. When they reached 8 cm cervical dilation, vaginal examinations were performed every 30 min in an attempt to accurately determine when the cervix was completely dilated. Randomization occurred upon confirmation of full dilatation of the cervix at which point the woman was asked to select one envelope from a set of 10 with using block randomization (Fig. 1). In the valsalva pushing group, women were coached by the investigator to use closed-glottis pushing three to four times during each contraction immediately when cervical dilation reached 10 cm and to continue pushing using this method with each contraction until birth. The investigator counted to 10 during each pushing effort to assist the woman in holding her breath for at least 10 s. In the spontaneous pushing group, women were assessed as having full dilatation of the cervix, the investigator providing care suggested they commenced pushing only when they felt the urge to do so and gave no specific instructions about the timing of pushing, duration of pushing and their positions. Fetal heart rate pattern was evaluated with electronic fetal monitorization. According to routine application of the clinic, women gave birth in lithotomy position in expulsion stage of labor. Episiotomy was performed by principal

Table 2
Pushing instructions applied to groups.

Valsalva pushing group	Spontaneous pushing group
Case was told to take a deep breath and hold it until the highest point of contraction. She was asked to push for 10 s at the peak point. She was told to take a deep breath again and pushing period was continued throughout contraction.	No verbal or visual instructions were given. She was informed to “act as her body demands”.

Table 3
Outcomes of the study.

Fetal/Neonatal outcomes	Maternal outcomes
• Meconium stained amniotic fluid rates • Fetal heart rate results • APGAR scores • Newborn resuscitation and intensive care requirement • Newborn trauma	• Duration of the second stage of labor • Perineal and cervical lacerations • Pelvic-perineal pain scores (visual analog scale 1th hour and 1th day after birth) • Average amount of blood loss (difference between prepartum-postpartum Hb levels) • POP-Q examination results • Q-tip test scores

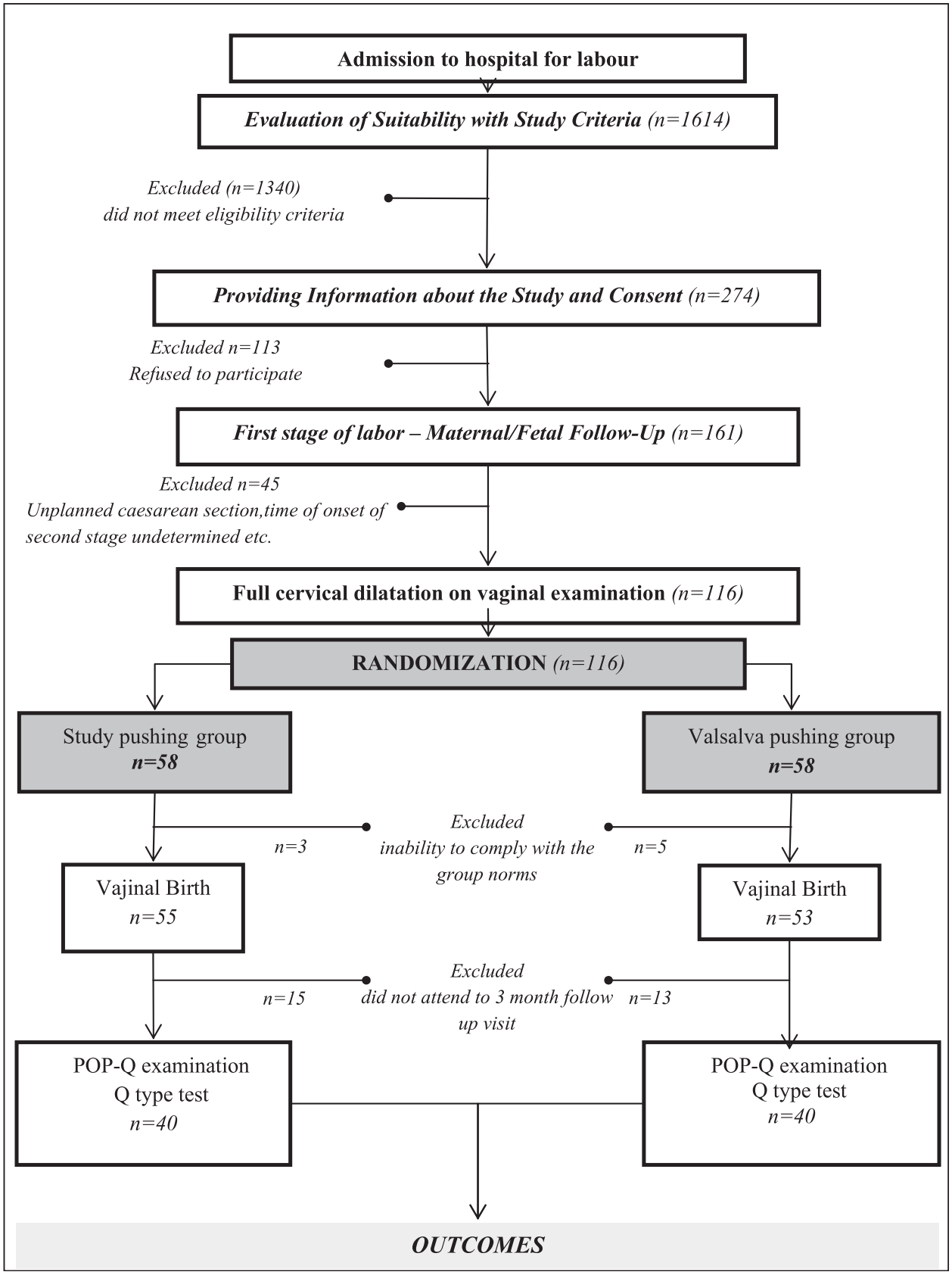

Fig. 1. Randomization, Participant flow.

investigator or obstetrician in labor. Minute 1 and 5 Apgar scores were recorded. Women were examined for perineal and cervical laceration. Postpartum haemorrhage was determined with hourly pad follow-up and prepartum and postpartum (24-h) Hb values. Pelvic-perineal pain scoring was performed by Visual Analog Scale at 1 h and 24 h postpartum period. Patients were given an appointment for after 3 months before discharge. At three months' postpartum, patients underwent a standardized pelvic floor evaluation and Q-tip testing by main investigator. Pelvic floor structure was assessed using the pelvic organ prolapse quantification (POP-Q) [17]. A rigid measuring device, such as a marked swab or sound calibrated in centimeters, was used. The posterior blade of the speculum was used to measure Aa, Ba, Ap and Bp. An intact speculum or posterior blade was used to measure the apical points C and D and TVL. The point of maximal prolapse was assessed with the patient in both the supine lithotomy and the upright positions by asking the patient to perform a maximum Valsalva effort. The Q-tip test was performed by measuring with a goniometer the angle between urethral axis at rest and urethral axis under maximal Valsalva manoeuvre. Urethral hypermobility was defined as a maximal straining angle greater than 30° as measured by the Q-tip test.

The duration of the second stage, fetal and newborn outcomes, perineal laceration rates, pelvic-perineal pain scores, POP-Q examination results, Q-tip test scores were compared between the two groups. Statistical analysis was performed using Statistical Package for the Social Sciences software (SPSS, Chicago, IL, USA). Independent t, chi-square, and Fisher exact tests were used to compare the findings and the significance level was set at 0.05. As the values of those variables were not normally distributed in the population, the Mann–Whitney U-test was used.

Results

A total of 1614 consecutive women presenting in labor were screened for participation in this study. Of these, 1340 women did not meet the study criteria and were excluded. 274 women consented and 113 women declined study participation. At the onset of the second stage of labor, 116 women were randomized to spontaneous or valsalva pushing. The remainder of the consented women were not eligible for randomization because of labor complications (n = 18), and time of onset of second stage undetermined (n = 27). Of the 116 randomized women, 108 (spontaneous n = 55, valsalva n = 53) completed the first stage of the study. The remaining 8 women were excluded from study in the second stage of labor (inability to comply with the group norms). Of the 108 women 80 (spontaneous n = 40, valsalva n = 40) returned for the 3-month postpartum visit for POP-Q examination and Q-tip testing. The remaining 28 women included 21 who did not attend their appointment and 7 who were unable to contact. 80 women (spontaneous n = 40, valsalva n = 40) successfully completed the study in total.

Participants' age, weight, height, body mass index, weight gain in pregnancy, and weeks' gestation are shown in Table 4. The mean age was 22.5 ± 3.52 years. All were married, housewives and had health insurance. 30% of women had 5 years of education, 54% had 8 years of primary education and 16% were literate. No significant difference was found between the two groups in demographic characteristics of the women and newborn.

All women delivered vaginally in the cephalic presentation. The mean length of the second stage of labour was 63.2 ± 21.3 min for the spontaneous pushing group and 46.6 ± 23.4 min for the valsalva pushing group. The mean duration of the second stage of labor in the valsalva pushing group was shorter than that in the spontaneous pushing group and the difference between groups was statistically significant (z = −4.271, p = 0.001). On the other hand, second stage period exceeding 2 h was only observed in one case of the spontaneous pushing group and groups were similar in their second stage period exceeding 2 h.

Differences in the incidence of episiotomy and perineal-cervical lacerations were not significant between two the groups (Table 3). Postpartum (24th hour) and prepartum (during application) Hb level difference was 0.60 ± 0.86 in spontaneous pushing group and 1.06 ± 1.18 valsalva pushing group. Decrease in Hb levels in valsalva pushing group was determined to be higher in a statistically significant degree (t = −1.995 p = 0.05) (Table 5).

No statistically significant difference was detected in fetal deceleration, meconium stained amniotic fluid and Apgar scores between valsalva pushing group and spontaneous pushing group (Table 6). No newborn resuscitation requirement, newborn intensive care requirement, or newborn trauma was observed in our study (clavicle fracture, long bone fractures, injury of brachial plexus, etc.) (Table 6).

The mean pelvic-perineal pain scores around 1 h post delivery were 5.30 ± 1.30 for the spontaneous pushing group, while the valsalva pushing group scored 6.10 ± 1.39. The mean pelvic-pain scores around 24 h post delivery were 2.42 ± 1 for the spontaneous pushing group, 2.30 ± 0.99 for the valsalva pushing group. No statistically significant difference was found in the mean pelvic-perineal pain scores (Table 7).

The results of POP-Q examination are presented in Table 7. Point Bp showed more descent in the valsalva pushing group vs the spontaneous pushing group (−2.00 ± 0.308 vs −2.11 ± 0.206), however, this was not statistically significant.

The results of Q-tip test scores are presented in Table 5. Significantly higher maximum straining angles were observed in valsalva group (27.3 ± 5.53 in spontaneous group, 30.3 ± 6.23 in valsalva group) (t = −2.277 p = 0.026).

Table 4
Demographic characteristics of women and newborns.

Characteristic	Spontaneous pushing group (n = 40) Mean ± SD	Valsalva pushing group (n = 40) Mean ± SD	t	z	p
Age	22.4 ± 3.5	22.6 ± 3.6		−0.242	0.808
Weight (kg)	75.9 ± 5.6	76.2 ± 4.6	−0.199		0.843
Height (cm)	161.5 ± 2.9	162.2 ± 2.3		−0.899	0.369
BMI	29.1 ± 1.8	28.9 ± 1.7	0.444		0.659
Gestational week	39.2 ± 0.3	39.2 ± 0.7		−0.097	0.923
Gestational weight gain (kg)	14.4 ± 2	13.9 ± 1.9		−1.028	0.304
Newborn					
Weight (g)	3201 ± 373	3193 ± 365	0.098		0.922
Height (cm)	49.8 ± 1.67	48.9 ± 2.12		−1.055	0.292
Head circumference (cm)	34.7 ± 1.47	34.3 ± 1.37		−1.352	0.176
Prepartum Hb levels	10.72 ± 1.21	10.55 ± 1.15	0.659		0.512

Table 5
Perineal/cervical tears in women and postpartum hemorrhage.

Characteristic	Spontaneous pushing group (n = 40)	Valsalva pushing group (n = 40)	t	x^2	p
Episiotomy	34 (85)	35 (87.5)		0.105	0.745
Perineal lacerations					
1st degree	3 (7.5)	2 (5)		5.113	0.236
2nd degree	3 (7.5)	3 (7.5)			
2nd degree with episiotomy	24 (60)	16 (40)			
Extended episiotomy	10 (25)	18 (45)			
Third degree	–	1 (2.5)			
Cervical lacerations					
(+)	1 (2.5)	4 (10)		2.047	0.359
(−)	39 (97.5)	36 (90)			
*Postpartum haemoglobin	9.87 ± 1.05	9.10 ± 1	3.341		***0.001***
*Rate of decline in Hb levels	0.60 ± 0.86	1.06 ± 1.18	−1.995		0.05

Values are number (%) unless otherwise stated *Mean ± SD.

Table 6
Fetal and newborn findings.

Characteristic	Spontaneous pushing group (n = 40)	Valsalva pushing group (n = 40)	z	x^2	p
Fetal findings					
Electronic fetal monitoring					
Early decelerations	2 (5)	5 (12.5)		3.393	0.20
Variable decelerations	1 (2.5)	4 (10)			
Late decelerations	–	–			
Prolonged decelerations	–	–			
Tachycardia	–	–			
Bradycardia	–	–			
Meconium stained amniotic fluid					
Clear	39 (97.5)	37 (92.5)		1.099	0.29
Meconium stained	1 (2.5)	3 (7.5)			
Newborn findings					
APGAR score (Min 5)	9.75 ± 0.63	9.52 ± 0.75	−1.587		0.11
Intensive care requirement	–	–			
Resuscitation requirement	–	–			

Values are number (%) unless otherwise stated *Mean ± SD.

Table 7
Postpartum maternal findings.

Characteristic	Spontaneous pushing group (n = 40)	Valsalva pushing group (n = 40)	t	z	p
Pelvic-perineal pain *(Visual Analog Scale Scores)*					
1 h after birth	5.30 ± 1.30	6.10 ± 1.39		−2.662	0.08
24 h after birth	2.42 ± 1	2.30 ± 0.99		−0.582	0.561
POP-Q examination *(3 months after birth)*					
Aa	−1.85 ± 0.228	−1.90 ± 0.228		−1.186	0.235
Ba	−1.85 ± 0.228	−1.90 ± 0.228		−1.186	0.235
C	−6.88 ± 0.446	−6.91 ± 0.477		−0.764	0.445
gh	3.10 ± 0.328	3.20 ± 0.337		−1.583	0.113
pb	3.87 ± 0.345	3.96 ± 0.247		−1.388	0.165
tvl	9.50 ± 0.267	9.51 ± 0.243		−0.199	0.842
Ap	−2.11 ± 0.302	−2.09 ± 0.295		−0.376	0.707
Bp	−2.00 ± 0.308	−2.11 ± 0.206		−1.799	0.072
D	−8.01 ± 0.329	−8.01 ± 0.288		−0.011	0.991
Q-tip test scores *(3 months after birth)*					
Resting angle	−4.30 ± 7.12	−3.47 ± 6.16	−0.554		0.581
Angle at maximum straining	27.3 ± 5.53	30.3 ± 6.23	−2.277		0.026

Values are Mean ± SD unless otherwise stated.

Discussion

In this analysis, there were three statistically significant findings found concerning the women randomly assigned to spontaneous or valsalva pushing during the second stage of labor. First, the average duration of the second stage of labor in the valsalva pushing group was shorter than that in the spontaneous pushing group. Second, rate of decline in Hb levels were significantly higher in valsalva pushing groups. Third, maximum urethral straining angle scores were significantly higher in valsalva group. Aside from these statistically significant findings, there were no differences in any clinically significant outcomes suggesting that coached expulsive effort is not advantageous.

In the study by Beynon [1], duration of the second stage of labor with spontaneous pushing was determined to be less than 2 h in average. Barnett and Humenick [10] remarked that second stage was longer with spontaneous pushing. Roberts et, al [13] stated this period as 45 min in average. In Thomson's study [15], average second stage length was 121,4 min in spontaneous pushing cases while it was 58 min in valsalva pushing cases. Bloom and et al. [5], demonstrated this period as 59 min for spontaneous pushing and 46 min for valsalva pushing. Similarly, in our study, second stage

periods of women who were allowed to push according to natural urge of their body without any intervention were determined to be longer compared to women who were actively encouraged to push with valsalva maneuver. On the other hand, no difference was observed between pushing techniques in terms of prolonged second stage (>2 h). The fact that no prolongation was observed in the second stage suggest that labor can be performed within normal time limits with spontaneous pushing, and that compelling pushing interventions are not necessary in cases with no indication for shortened second stage. Beynon has shown that 81% of cases with spontaneous pushing has given birth without any directions. In our study, all women allowed to push spontaneously without any verbal or visual directions were observed to complete vaginal delivery [1].

The duration of active pushing may have an effect on fetal and newborn health. Prolonged pushing and breath holding can cause changes in the maternal cardiovascular system and uteroplacental perfusion, leading to changes in the acid-base balance of the fetus and development of fetal hypoxia and acidosis [6,9]. Aldrich [18] has demonstrated a significant increase in fetal cerebral deoxyhemoglobin and in cerebral blood flow, and significant decrease in cerebral oxygen saturation with valsalva pushing. It was stated that this long term maternal pushing effort caused significant decrease in fetal cerebral oxygenation and increased cerebral blood volume; these changes may not be important for a healthy fetus, however; it may have important outcome for a fetus entering second stage with low oxygenation. Piquard indicated fetal pH, pCO_2 and lactic acid levels were stable in fetal scalp blood sampling in spontaneous pushing group and decreased pH, increased pCO_2 and lactic acid levels were only observed in active pushing cases [19]. Bloom and et al. have demonstrated a significant increase in the incidence of meconium-stained amnionic fluid with coached women [5]. In this study, fetal wellness was evaluated with electronic fetal monitorization and the presence of meconium stained amniotic fluid. There were no statistically significant differences between groups in electronic fetal monitorization results and presence of meconium stained amniotic fluid. Several studies reported no significant difference in the need for resuscitation of newborns with either spontaneous or valsalva pushing techniques [15,20,21].

No statistically significant difference was reported by Yeates and Roberts [16]; Parnell, Roos, Iversen and Damgaard [22] in terms of Apgar scores in their study. Yildirim and Beji [23] reported Apgar scores of the newborns in spontaneous pushing women were significantly higher than those in the newborns of valsalva pushing women. No difference was observed in our study in terms of Apgar scores, newborn resuscitation and intensive care requirement. Although spontaneous pushing is more physiological for the mother and infant, no significant difference was observed in terms of newborn results in many studies in the literature and in our study.

During vaginal delivery, the pelvic floor is exposed to compression and extreme pressures from the fetal head and maternal expulsive efforts. Gentle pushing and slower descent of fetal head causes less trauma to pelvic structures [1]. Flynn et al. [3] have shown that less aggressive pushing is associated with better perineal results in second stage management. Sampselle and Hines [4] has indicated that episiotomy, 2nd-3rd degree laceration rates were less in cases with spontaneous pushing and they had more intact perineum. Albers et al., [2] suggested that the possibility of perineal lacerations requiring suturation are higher in valsalva pushing. Fitzpatrick et al., [11]; Schaffer et al. [14] stated that there was no difference between spontaneous pushing and valsalva pushing in terms of anal sphincter damage. Our study, as in those of Thomson [15]; Yildirim and Beji [23]; Bloom et al., [5] showed no difference in either pushing groups with respect to perineal or cervical tears. While there were no statistically significant differences between groups in terms of perineal trauma, the third degree laceration was only observed in a case belonged to the valsalva pushing group. In addition, the number of cervical laceration cases and especially extended episiotomy were found to be higher in valsalva pushing group.

Le ray et al. [21] stated that postpartum haemorrhage was associated with pushing techniques. Yildirim and Beji [23]; Thomson [13] remarked there were no such relation. In the present study, decrease in Hb value of the valsalva pushing group was found to be higher in a statistically significant degree. We think that postpartum Hb differences are caused by episiotomy extension and cervical laceration cases that are observed more particularly in valsalva group.

Vaginal birth is a recognized factor in postpartum perineal pain. In this study, no statistically significant difference was observed in the mean pelvic-perineal pain scores.

POP is essentially a form of herniation of the vaginal wall due to laxity of the collagen, fascia and muscles within the pelvis and surrounding the vagina. Vaginal birth increases a women's risk of prolapse greater than an elective C-section. However, there is limited data available about the relationship between pushing techniques used in vaginal birth and POP development. Schaffer et al. [14] have shown that the POP-Q point Bp was negatively affected after 3 months of birth by coached pushing. In our study, no statistically significant difference was detected in terms of the POP-Q points at 3 months after childbirth. On the other hand, significantly higher maximum straining angles were observed in valsalva group.

Various studies have investigated the outcomes of different pushing methods. There is a growing evidence supporting the use of spontaneous maternal pushing for both maternal and fetal benefit and a few studies have specifically compared directed pushing and spontaneous pushing methods [4,5,12,14–16, 20,21,23]. Moreover, some studies comparing the effects of spontaneous versus directed pushing revealed more positive effects on perineal integrity when spontaneous pushing methods were adopted [2,4,8,14].

Conclusion

According to the study results, we believe that generalizing spontaneous pushing in our country and worldwide is beneficial for delivery process among all healthcare professionals responsible for delivery.

We suggest spontaneous pushing for the following reasons;

- Although it may cause prolongation in second stage of labor, mothers can complete delivery without exceeding limit value of 2 h
- Fetal wellness and neonatal results are not affected.
- Allowing respiration during pushing effort makes it a method of less intervention with physiological balance.

With these characteristics, it seems to be the method more suitable for preventing possible effects of valsalva maneuver on maternal and fetal physiology and ensuring continuity of fetal oxygenation. By ensuring a more controlled labor for pelvic structures, it is a more suitable method for pelvic floor integrity.

Details of ethical approval

Ethical approval for the study was obtained from Ethics Committee of Istanbul Gaziosmanpaşa-Taksim Training and Research Hospital (ref. no. 2013-05-25).

Conflicts of interest

The authors have no conflicts of interest to disclose.

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