

Waterbirths: A Comparative Study

A Prospective Study on More than 2,000 Waterbirths

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Key Words

Waterbirth · Alternative birth method · Birth concept · Maia-birthing stool · Episiotomy · Perineal laceration · Bedbirth

Abstract

Background: Waterbirths were introduced in 1991 as part of a new birth concept which consisted of careful monitoring and birth management, restrictive use of invasive methods and free choice of different birth methods. **Methods:** After the introduction of this new birth concept a prospective observational study was initiated. All parturients of the region give birth in our clinic without preselection, ours being the only birth clinic of the region. 2% of the parturients will be referred to a larger birth clinic (university clinic) mainly because of preterm births before the end of the 33rd week of pregnancy. Every one of the 7,508 births between November 1991, and May 21, 1997, was analyzed. In this article the birth parameters of mother and child in the most often chosen spontaneous birth methods will be compared to assess the safety of alternative birth methods in general and of waterbirths in particular. 2,014 of these 5,953 spontaneous births were waterbirths, 1,108 were Maia-birthing stool births and 2,362 bedbirths (vacuum extractions not included). **Results:** The parity and age of the mother as well as the newborn's birth weight are comparable in all 3 groups: waterbirth, Maia-birthing stool, and bedbirths. An episiotomy was performed in only 12.8% of the births in water, in 27.7% of the births on the Maia-birthing stool

and in 35.4% of the bedbirths. These differences are statistically significant. In spite of the highest episiotomy rates, the bedbirths also show the highest 3rd- and 4th-degree laceration rates (4.1%), thus the difference between the rates for bedbirths and alternative births methods for severe lacerations is significant. The mothers' blood loss is the lowest in waterbirths. Fewer painkillers are used in waterbirths and the experience of birth itself is more satisfying after a birth in water. The average arterial blood pH of the umbilical cord as well as the Apgar scoring at 5 and 10 min are significantly higher after waterbirths. Infections of the neonate do not occur more often after waterbirths. No case of water aspiration or any other perinatal complication of the mother or child which might be water-related was reported. **Conclusion:** Waterbirths and other alternative forms of birthing such as Maia-birthing stool do not demonstrate higher birth risks for the mother or the child than bedbirths if the same medical criteria are used in the monitoring as well as in the management of birth.

Introduction

A new birth concept [1] was introduced in 1991 at our clinic for obstetrics and gynecology of the cantonal hospital of Frauenfeld, Switzerland. This concept consisted of the careful monitoring and management of the birth process, the restrictive use of invasive methods as well as the free choice of the birth method. This was introduced in

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Fig. 1. Waterbirth.

response to the growing desire of many parturients for alternative birth methods, more respect of the natural birth process and less aggressive birth management. The wishes of the parturients were taken seriously. Waterbirths, to be understood here as the birth of the baby under water, and other alternative birth methods such as the Maia-birthing stool were offered. The natural process of birth was respected, medical measures and technique are toned down, without compromising the security that classical medicine offers.

A prospective observational study was started on the November 1, 1991, to answer the question of how safe waterbirths and other alternative birth methods are, and to counter prejudice with relevant data. The aim of this study is to compare the quality of alternative birth methods, especially that of waterbirths (when the quality of the monitoring and the birth management is unchanged), with traditional 'bedbirth'.

Birth Management in Frauenfeld

The midwife supports the parturient during the different stages of labor. The parturients have a chance to try different positions in or out of the water (where they are never left unattended and can regulate the water temperature themselves) and accordingly choose the birth method they feel the most comfortable with. They have the follow-



Fig. 2. Maia-birthing stool.

ing possibilities to try and choose from: different positions on the wide bed, sitting on the Maia-birthing stool, the 'Roma' wheel, or the birthing bag, 'on all fours' on a mat or in the upright position by holding a rope, or the bath tub (fig. 1-5). The husband/partner and midwife (more seldom the doctor) might help in the decision making. Choosing the birth method is a process which might end only with the birth itself.

The parturient may eat and drink as much as she wishes. If she feels nauseated or thirsty she will receive more fluids intravenously whether she is in or out of the tub.

The management of the different stages of labor and the monitoring of the fetal heart rate are done in the same way, independent of the birth method. We monitor the fetal heart rate electronically, usually intermittently during the first stage of labor, and continuously in the second stage of labor because this seems to be less disrupting at this point than intermittent monitoring. In most cases monitoring is external; of course only a telemetrical monitoring system can be used in waterbirth (we use the monitoring systems of Hewlett Packard and Corometrics with watertight transducers). The indication of a vaginal operative delivery or cesarean section remain the same, independent of the birth method chosen.

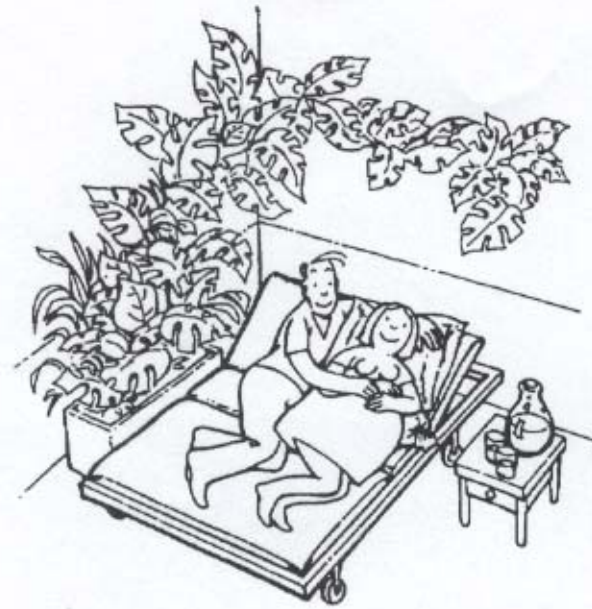


Fig. 3. Wide bed.

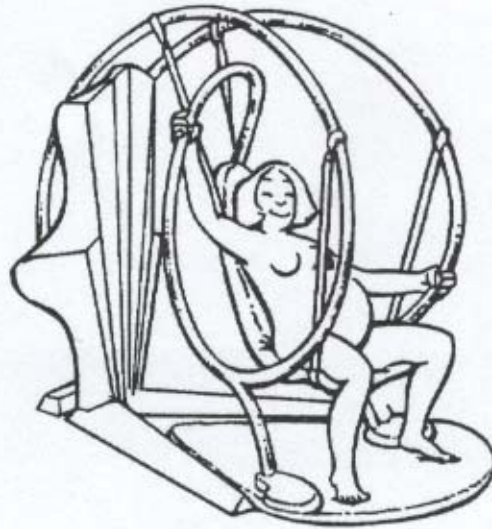


Fig. 4. 'Roma' wheel.



Fig. 5. Birthing bag, mat and rope.

The delivery room team has the choice between different kinds of analgesics. In general the parturient and the midwife/doctor decide together which type of analgesics and what dose will be needed; these decisions are taken individually in every case. The choice extends from suppositories, injections (Hyoscinebutylbromid, Propyphenazon, Tramadol), homeopathic remedies (classical home-

opathy), and acupuncture to epidural analgesia. Epidural analgesia is performed by the anesthesiologist on duty.

A midwife and a doctor are always present at birth. The midwife or the doctor guards the perineum (in or out of the water in an identical fashion). Depending on the individual situation the midwife will suggest sponta-

neously pushing or pushing on command. In a waterbirth the baby is immediately brought to the surface after birth, emerges face down and is put on its mother's chest.

The umbilical cord is then clamped, the blood collected for the arterial and venous pHs which are determined in the delivery room itself (Chiron diagnostics 248 h). The Apgar scoring system is applied at 1, 5 and again at 10 min after birth. The newborn infant is closely observed as it lies on its mother's chest, and it is kept warm with a preheated towel or in the water with an overhead infrared heater.

The third stage of a waterbirth usually takes place in the water while the mother holds her child.

Methods

Our birth clinic meets the obstetrical needs of a clearly defined, mostly rural region of 150,000 inhabitants. The yearly birth rates have fluctuated between 1,216 and 1,421 births during the observation period (1991–1997). All parturients of the region give birth in our clinic without preselection, ours being the only birth clinic of the region. 2% of the parturients are referred to a larger birth clinic (university clinic) mainly because of preterm births before the end of the 33th week of pregnancy. The referral rate and the reasons for referral remained basically the same during the observational period.

On the November 1, 1991, we started a prospective observational study and since then have documented every birth with a standardized questionnaire in five parts [1]. We have collected parameters concerning the mother and child in this way. The parturient receives the first part of the questionnaire at home 6–8 weeks before birth, and brings the completed form with her when she enters the hospital for birth. In this part of the questionnaire, the mother-to-be is asked questions about her expectations and wishes concerning birth management, birth methods and the expected pain. She may also express her fears. During labor, after birth and again before the new mother leaves the hospital (usually 4–7 days after birth) the attending midwife and doctor record the objective information concerning labor, birth and the postpartum phase. In addition to this objective information, the mother is asked questions about the pain experienced during the different stages of labor, and about her birth experience in general. A 100-mm-long visual analog scale is then shown with the term 'wonderful' to the left and the term 'dreadful' to the right. The woman marks a line, more to the left or to the right, depending on how she feels about her birth experience. A minimal comprehension of the German language as well as a little time are required for this part of the questionnaire. We use a 'short' questionnaire containing only the questions on objective data for the 25% non-German-speaking parturients.

For the purposes of this article we used the objective data concerning all the births between November 1, 1991, and May 21, 1997, a total of 7,508 births.

Why a Randomized Study Was Impossible, and Why We Choose the Place of Birth to Define Our Birth Method Groups

When we conceived the study, it was already clear that a randomization would not be accepted by our parturients. They wanted to

decide on the birth method themselves and be able to change their minds during labor.

In the prenatal part of the questionnaire of the prospective observational study, the parturients' wishes concerning birth methods prior to birth, expressed 6–8 weeks before birth, are not as clear as one might think. Waterbirth is the most commonly named wish at this point, but most women can imagine other birth methods as well, and express this in the questionnaire by indicating different possibilities. The factors that influence the choice of a birth method are complex and will be addressed in a separate paper. The different aspects that could influence the woman's decision are: personal past experience of labor as well as related birth experiences (relatives, books etc.); the partner's wishes and experience of birth; the midwife's suggestions and preferences, and of course the on-going labor (experiencing the contractions and finding the optimal way to cope with the pain during labor).

The decisive factor and only clearly defined element for the definition of the birth method is the actual place of birth so that we defined the birth method itself as intervention. All births in the waterbirth group are therefore defined as complete births of the baby under water while the mother remains in the tub. A similar definition is used for all other birth methods. These definitions were chosen for their simplicity and their clarity.

The statistical analysis is computerized (Systat 5–0 for windows). We used the χ^2 test when analyzing qualitative information and the Mann-Whitney U test when analyzing quantitative data, since our data did not follow a normal distribution (statistical counseling: Prof. T. Gasser, Department for Biostatistic, Institute of Social and Preventive Medicine, University of Zurich, Switzerland).

Results

79.3% of the 7,508 analyzed births are spontaneous single births in cephalic presentation (table 1). 9.6% of the 7,508 births were cesarean sections, a low rate for Switzerland, 8.4% of the births were operative vaginal deliveries; we prefer vacuum to forceps extraction. 1.8% of the births were spontaneous breech births and 0.9% spontaneous twin births.

The group of spontaneous singleton births in cephalic presentation is composed of the following subgroups (table 2): 2,014 births in water; 1,108 births on the Maia-birthing stool; 2,362 births on a wide bed in a half-sitting position (vacuum extractions are *not* included in the bed-birth group), and 469 not as popular birth methods such as the 'Roma' wheel, the birthing bag, 'on all fours', or standing with or without the assistance of the rope or the wall bars.

The following distribution concerning parity was found: 34% of the waterbirth group, 35% of the Maia-birthing stool group, 35% of the bedbirth group and 32.5% of the group including the rarer birth methods were nulliparous women. The average age of the mothers-to-be

Table 1. Groups of vaginal births and cesarean sections

Births	n	%	
Vaginal births			
Single spontaneous births with cephalic presentation	5,953	79.3	
Breech, single, vaginal births	135	1.8	
Twin, vaginal births	66	0.9	
Vacuum extraction of singleton with cephalic presentation	632	8.4	
Cesarean sections			
Elective cesarean deliveries	317	4.2] 9.6
Nonelective cesarean deliveries	405	5.4	
Total	7,508	100	

Table 2. Birth methods used in spontaneous single births with cephalic presentation

Birth methods	n	%
Water	2,014	34
Maia-birthing stool	1,108	18
Bed (vacuum extractions excluded)	2,362	40
Others ('Roma' wheel, birthing bag, rope, 'on all fours' standing)	469	8
Total	5,953	100

was 29 in the different groups. 40 weeks was the average pregnancy length in all groups. The average length of births is 305 min in the waterbirth group, 335 min in the Maia-birthing stool group and 344 min in the bedbirth group. 22% of the women in the waterbirth group, 29% in the Maia-birthing stool group and 47% in the bedbirth group were foreigners (mostly from southern and eastern Europe).

Shoulder dystocia occurred 6 times (0.29%) in the waterbirth group, never in the Maia-birthing stool group, and 11 times (0.46%) in the bedbirth group.

Meconium-stained amniotic fluid was observed in 100 parturients (5%) in the waterbirth group, in 101 parturients (9.1%) in the Maia-birthing stool group and in 297 parturients (12.6%) in the bedbirth group.

The average rate of preterm rupture of the membranes and induction of labor were the same with around 8 and 11% in the different groups.

The results of a comparison of different aspects of birth (perineal injuries, blood loss, neonatal birth parameters, use of analgesics and birth experience) for the three most common spontaneous birth methods for singletons in

cephalic presentation (waterbirth, Maia-birthing stool, bedbirths) follow.

Perineal Injuries (table 3)

Comparing the episiotomy rates of the three most common birth methods, we see that at 12.8% the episiotomy rate is the lowest after waterbirths; bedbirths reach 35.4%, the highest of the episiotomy rates. The differences in rates between the three birth methods are statistically significant.

The bedbirths in our study presented the highest rates of 3rd- and 4th-degree lacerations. We found only 2.7% of 3rd- and 4th-degree tears after waterbirth and 2.3% after birth on the Maia-birthing stool. This difference is not significant, whereas in alternative birth methods and bedbirths the differences in rates are significant. The frequency of 1st- and 2nd-degree lacerations are found statistically significantly more often after waterbirths and Maia-birthing stool births than after bedbirths. There is no tearing at all in a statistically significantly higher number of waterbirths (27.6%) compared to 22.2% after births on the Maia-birthing stool and 24.9% after bedbirths.

However, there are significantly higher numbers of labia tears after waterbirths than after Maia-birthing stool births or bedbirths. Clitoris tears are luckily very rare in all birth methods.

Blood Loss (table 4)

The mother's blood loss is defined as a drop in hemoglobin (g/l), the hemoglobin levels being determined before birth and again on the 2nd-4th day after birth, 1,809 waterbirths, 1,004 Maia-birthing stool births and 2,245 bedbirths were analyzed to determine the amount of blood loss. The lowest blood loss was found after waterbirths. The highest blood loss was found after Maia-birthing stool births. The differences in blood loss between

Table 3. Genital lesions after waterbirth, Maia-birthing stool, and bedbirths

Genital wounding through birth	Water (A)		Maia-birthing stool (B)		Bed (C)		Difference		
	n	%	n	%	n	%	A versus B	A versus C	B versus C
	Number of patients	2,014		1,108		2,362			
Episiotomy	275	12.8	307	27.7	838	25.4	p < 0.001 (s.)	p < 0.001 (s.)	p < 0.001 (s.)
Laceration									
1st- to 2nd-degree	1,031	51.2	517	46.7	822	34.8	p < 0.05 (s.)	p < 0.001 (s.)	p < 0.001 (s.)
3rd- to 4th-degree	55	2.7	26	2.3	97	4.1	p > 0.05 (n.s.)	p < 0.05 (s.)	p < 0.05 (s.)
No tear at all	555	27.6	246	22.2	587	24.9	p < 0.05 (s.)	p < 0.05 (s.)	p > 0.05 (n.s.)
Vaginal tear	398	19.8	160	14.4	344	14.6	p < 0.05 (s.)	p < 0.0001 (s.)	p > 0.05 (n.s.)
Labia tear	430	21.4	152	13.7	305	12.9	p < 0.0001 (s.)	p < 0.0001 (s.)	p > 0.05 (n.s.)
Clitoris tear	12	0.6	6	0.5	16	0.7	p > 0.05 (n.s.)	p > 0.05 (n.s.)	p > 0.05 (n.s.)

s. = Statistically significant; n.s. = not statistically significant.

waterbirths and other birth methods, as well as between Maia-birthing stool births and bedbirths are both statistically significant. Ambulatory births, in which the mother prefers to spend her childbed at home and therefore leaves the hospital within 24 h of birth, account for the missing hemoglobin values in these groups.

Neonatal Birth Parameters (table 5)

An average birth weight of 3,430 g was found after waterbirths, 3,400 g after Maia-birthing stool births and 3,390 g after bedbirths. There was no significant difference in birth weight between bed-, water- and Maia-birthing stool births.

The average arterial blood pH was 7.30 after waterbirths, 7.29 after Maia-birthing stool and 7.26 after bedbirths. These differences are significant.

The average Apgar score at 5 min is significantly higher after waterbirths than after bedbirths, and also significantly higher after Maia-birthing stool births than after bedbirths. The average Apgar scores at 10 min show the same significant differences as at 5 min.

Missing measurements or the missing documentation of measured values account for the smaller numbers for the analysis of the different neonatal parameters.

0.6% of the newborn infants born in water, 1.1% of the babies born on a Maia-birthing stool and 1.05% of the babies born in bed suffered from an infection. The differences between our 3 groups are not statistically significant. The commonest infection of the neonate found during the first week of life is nonspecific conjunctivitis. Pneumonia, infections of the urinary tract, skin infections and diarrhea are rare.

Table 4. Blood loss in different birth methods: comparison of hemoglobin drop before birth and 2–4 days after birth

	Water	Maia-birthing stool	Bed
Number of patients	1,809	1,004	2,245
Mean, g/l	-4.1	-9.1	-6.6
Max./min.	-40.2/+10.9	-60.0/+4.2	-58.2/+12.8
SD	14.4	18.7	18.6
	p < 0.0001 (s.)		p < 0.0001 (s.)
	p < 0.0001 (s.)		

s. = Statistically significant; Max./min. = maximal/minimal data.

Use of Analgesics (table 6)

70.6% of the women who gave birth in water, 66.1% of the women who gave birth on the Maia-birthing stool and 54.1% of the women who gave birth on a bed needed no pain killers at all. The differences between the waterbirth group and the Maia-birthing stool group are significant; the differences between the waterbirth group and the bed-birth group are even highly significant.

The women who gave birth on a bed had the highest need of analgesics. The women who gave birth in water used fewer analgesics in all but one category: they had the highest use of homeopathic remedies. The 3 groups show significant differences in the use of painkillers: the water-birth group used fewer suppositories, injections, and epidural analgesics, but more homeopathic remedies. The

Table 5. Neonatal birth parameters in different birth methods: birth weight, arterial umbilical cord blood pH, Apgar scores at 5 and 10 min after birth, neonatal infections

	Water	Maia-birthing stool	Bed
Weight			
Number of patients	2,012	1,106	2,359
Mean, g	3,430	3,400	3,390
SD	477	456	520
	p = 0.41 (n.s.)		p = 0.45 (n.s.)
	p = 0.06 (n.s.)		
Arterial blood pH of the umbilical cord			
Number of patients	1,991	1,095	2,322
Mean	7.30	7.29	7.26
Min./max.	7.01/7.50	6.98/7.45	6.95/7.48
SD	0.77	0.85	0.78
	p = 0.005 (s.)		p < 0.0001 (s.)
	p < 0.0001 (s.)		
Apgar 5 and 10 min			
Number of patients	2,011	1,106	2,354
Mean	9.8 and 9.9	9.8 and 9.9	9.6 and 9.9
Min./max.	7/10 and 7/10	5/10 and 7/10	5/10 and 7/10
SD	0.5 and 0.3	0.6 and 0.4	0.7 and 0.3
5 min	p = 0.61 (n.s.)		p < 0.0001 (s.)
	p < 0.0001 (s.)		
10 min	p = 0.25 (n.s.)		p = 0.001 (s.)
	p < 0.0001 (s.)		
Neonatal infections			
Number of patients	2,014	1,108	2,362
Pulmonary		1	1
Urogenital		1	
Ocular	10	9	20
Others	2	1	4
Total	12 (0.6%)	12 (1.1%)	25
	p > 0.05 (n.s.)		p > 0.05 (n.s.)
	p > 0.05 (n.s.)		

s. = Statistical significant difference; n.s. = not statistically significant difference; Min./max. = minimal/maximal data.

bedbirth group and Maia-birthing stool group also show a significant difference: the Maia-birthing stool group used fewer suppositories, injections, and epidural analgesia as well as much smaller number of homeopathic remedies. It is basically possible to have a waterbirth with an epidural analgesia. In practice, women will usually give birth in water with an epidural catheter when this analgesia was needed during the first stage of labor, and then discontinued in the second stage. Homeopathic remedies are prescribed by midwives trained in classical homeopathy.

Birth Experience, Visual Analog Scale (table 7)

1,587 women after waterbirths, 770 women after Maia-birthing stool births and 1,315 women after bedbirths have returned the questionnaire with the visual analog scale on their birth experience (100-mm-long visual analog scale with the word 'wonderful' to the left and the word 'dreadful' to the right). The number of foreigners is higher in the bedbirth group and this is the reason why fewer women of this group answered the questions on birth experience that require a minimal command of the

Table 6. Use of analgesics in birth management

Use of analgesics	Water (A)		Maia-birthing stool (B)		Bed (C)		Difference		
	n	%	n	%	n	%	A versus B	A versus C	B versus C
Number of patients	2,014		1,108		2,362				
No painkillers	1,422	70.6	732	66.1	1,279	54.1	p < 0.05 (s.)	p < 0.0001 (s.)	p < 0.0001 (s.)
Suppositories	238	11.8	177	15.9	496	20.9	p < 0.001 (s.)	p < 0.0001 (s.)	p < 0.001 (s.)
Injections	205	10.2	162	14.6	533	22.6	p < 0.001 (s.)	p < 0.0001 (s.)	p < 0.0001 (s.)
Epidural analgesia	8	0.4	22	2.0	191	8.1	p < 0.0001 (s.)	p < 0.0001 (s.)	p < 0.0001 (s.)
Homeopathic remedies, etc.	442	21.9	171	15.4	438	18.5	p < 0.0001 (s.)	p < 0.01 (s.)	p < 0.05 (s.)

s. = Statistically significant difference.

German language. The difference between waterbirths and Maia-birthing stool births is significant, the difference between alternative birth method (waterbirth and Maia-birthing stool birth) and bedbirths is also significant. The experience of birth after a waterbirth is closer to 'wonderful' than after a Maia-birthing stool birth, a bed-birth being the furthest away from 'wonderful' birth experiences.

Discussion

Waterbirths have rapidly become the most popular birth method. They make up 34% of the 5,953 spontaneous single births with cephalic presentations of this study, making this therefore the most often chosen alternative birth method. In the past 3 years waterbirths have reached more than 40% of the spontaneous single births [1].

There have been different reactions to the introduction of alternative birth methods, and especially waterbirths. The mothers-to-be were delighted. The great interest the media showed was quite unexpected, and our clinic was suddenly propelled into the limelight, caught between alternative circles that supported us [2-6] and classical obstetrical circles that were in opposition [7-11]. These issues were debated at different Swiss and German conferences. The opponents to waterbirths were afraid of possible complications: aspiration of the bathwater; drowning of the newborn infant; higher rates of 3rd- and 4th-degree lacerations; postpartal blood loss; infections of the neonate and of the mother; hyper- or hypothermia.

As the data and experience were scarce in this field these fears were quite understandable. To give answers to these questions and fears we decided to start a prospective

Table 7. Birth experience as perceived by the mother 4-7 days after birth on a 100-mm long visual analog scale with the term 'wonderful' to the left and the term 'dreadful' to the right

	Water	Maia-birthing stool	Bed
Number of patients	1,587	770	1,315
Mean, mm	31.3	34.6	42.2
SD	20.5	21.6	23.4
Min./max.	0/100	0/100	20/100
	p = 0.003 (s.)		p < 0.0001 (s.)
	p < 0.0001 (s.)		

s. = Statistical significant difference; Min./max. = minimal/maximal data.

observational study. The first results of our observational study [12-16] and studies from Germany [17, 18] already showed quite clearly that with careful monitoring and birth management the feared complications did not occur.

The episiotomy is the commonest but also the most questioned practice in obstetrics [19, 20]. Even if studies have proven the contrary [21-24], it is still a widespread belief that with episiotomies 3rd- and 4th-degree lacerations are avoided, that they are easier to repair, and that they heal better than lacerations. In our study the episiotomy rates were lowest after waterbirths, and the 3rd- and 4th-degree lacerations significantly less frequent than in bedbirths which also have the highest episiotomy rates. We see no preventive effect of an episiotomy on severe perineal lacerations. The question as to why the episio-

my rates are lower in waterbirth remains unanswered: Are the tissues made softer by the warm water so that they extend more easily? Or is the perineum simply more difficult to get at in water than in a bedbirth? This second possibility is supported by the fact that there are significantly fewer episiotomies performed in Maia-birthing stool births where the perineum is also not as easy to get at as in bedbirth.

The lower blood loss in waterbirths could be explained by the hydrostatic pressure in the tub, by the less important perineal lacerations or possibly by a facilitated control of the third stage of labor (blood spreading in water is perceived as more impressive than blood on a bed being absorbed directly). The bleeding in the Maia-birthing stool birth is probably stronger because of the high hydrostatic pressure in the wound in an upright sitting position. To keep the blood loss as low as possible, the women could change from upright- to lying position after birth for the third stage of labor.

The results concerning the neonates' birth parameters such as pH of the arterial umbilical cord blood and Apgar scores, are especially encouraging. In over 2,000 waterbirths we have never had a case of aspiration of the bath water. No neonate has ever drowned or died after birth as a consequence of a waterbirth. This has been explained by an inhibitory reflex – the diving reflex [25–27] which shows that when the face, or especially the glottis, comes in contact with a fluid, respiration movements are inhibited. It was postulated that this diving reflex is responsible for the inhibition of water aspiration in utero as well as during a birth in water and later in life when diving. Aspiration will occur only when the diving reflex fails, because of anesthesia or severe asphyxia. The mechanism also explains the far-reaching phenomenon of meconium aspiration in utero [28]. The fear that the neonates' first breath will be triggered by decompression of the thorax at birth and will thus cause water aspiration is therefore unfounded. The first breath will be taken only later when the face comes into contact with air.

Contrary to expectations and contrary to the small amount of literature that exists on the subject [29, 30], infections of the neonate after waterbirths were not more frequent than in other birth methods. A strong dilution of the micro-organism is obtained by the large quantity of water contained in our tubs (560 liters) and by continual water renewal. This probably reduces the risk of infections for the mother and child. There is of course no such thing as a sterile environment in any birth method, the vagina being colonized. It is clear that we still need microbiological studies to confirm these on-going hypotheses.

We have never seen a disregulation in body temperature of mother or child, even when the women wished to bathe for 2 h or even longer.

The need and the type of analgesics used in birth management are often discussed by obstetricians, midwives and mothers-to-be. Opinions on this subject differ widely [31, 32]. Women need fewer painkillers in waterbirths than in other birth methods. We think this has to do with the relaxing effect of water and the facilitated movement in its weightlessness. The greater freedom of movement and the immediate closeness of the partner in the Maia-birthing stool births may explain the lower use of painkillers in Maia-birthing stool births than in bedbirths. Because of these diversions the pain might seem more bearable.

Our analysis of the visual analog scale has shown that women who give birth in water have the most satisfying birth experiences; this is probably one of the reasons why this method has become the most popular birth method [33].

We are conscious of the fact that our birth method groups, waterbirth, Maia-birthing stool and bedbirth, are not comparable on all points. We have already mentioned the contradiction between our new birth concept and randomization. The precise analysis of the personality profile and risk profile of the women in these different birth method groups will be addressed in a different paper. We expect to find that the bedbirth group probably presents, as a whole, a higher risk profile than the other birth method groups because of its higher proportion of foreigners. Foreigners do not benefit from prenatal care as often or as regularly as the Swiss population because of the language barrier and lack of information about the local possibilities.

Our monitoring and birth management are the same in all birth method groups so that, for example, the indication for an operative delivery is the same. We have even noticed that our birth management in waterbirths is somewhat more careful than in the other groups so that parturients are asked to leave the tub at the slightest sign of an abnormal electronical fetal heart rate tracing. In this way the monitor tracings are evaluated more strictly in waterbirths than, for example, in bedbirths. This might explain the significantly higher arterial blood pH of the umbilical cord as well as the higher Apgar scores in waterbirths. In general preterm babies, that is before the 37th week of pregnancy, are not born in water. This is so that any respiratory distress syndrome is clearly seen to be caused by prematurity.

Seven years after the introduction of our new birth concept consisting of careful monitoring and birth management, the restrictive use of invasive methods, as well as the free choice of different birth methods, we conclude that waterbirths and other alternative birth methods can very well be integrated into classical birth management. Alternative birth methods introduce more caring into birth management, promote mutual respect, bring more comprehension and acceptance between parturients and the obstetrical team.

We also demonstrate with our data that waterbirths and other alternative birth methods are safe for the mother as well as for the child, provided that a consequent and correct obstetrical monitoring is assured. Furthermore waterbirths demonstrate advantages such as fewer epis-

otomies, higher rates of intact perineum, lower blood loss and lower use of painkillers. Moreover, neonatal infections do not occur more frequently and waterbirths may enhance the experience of birth. Of course we are not as naive as to think that the introduction of alternative birth methods will solve all problems. Obstetrical emergencies also occur in alternative birth methods, and these need prompt and correct handling. We want to emphasize again that conscientious obstetrical as well as careful birth management are always necessary, regardless of the birth method chosen. Good cooperation and a trusting relationship between the parturients and the delivery room team (midwives, doctors as well as other medical staff) is crucial for excellent and safe obstetrical management and the success of the delivery ward.

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