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Original Article

A comparative study between the pioneer cohort of waterbirths and conventional vaginal deliveries in an obstetrician-led unit in Singapore



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ABSTRACT

Objective: Waterbirth has been increasing in popularity in Asia (Lea W. Water babies. The Straits Times 17 February 2011. Available at http://www.nuh.com.sg/news/media-articles_1504.html). National University Hospital, Singapore, is the pioneer hospital offering waterbirths to women since 2006 in a unique setting of a consultant-led service and continuous foetal monitoring. To date, no studies have been done on the conduct of waterbirths in an Asia. This study aims to evaluate if water immersion during delivery is associated with increased rates of adverse maternal and foetal outcomes as compared with conventional vaginal deliveries.

Materials and Methods: Clinical records of women who birthed underwater at National University Hospital between 2010 and 2013 were retrospectively reviewed. Outcomes of interest were estimated blood loss, third- or fourth-degree tears, incidence of postpartum infections or haemorrhage, neonatal Apgars at 1 and 5 min, and neonatal complications requiring intensive care unit admission. Outcomes were compared against a matched control group of women who had conventional vaginal deliveries within ≤ 1 month.

Results: Records of 118 women who birthed underwater were accrued. There was no significant difference in estimated blood loss and postpartum haemorrhage between groups, and there were no cases of maternal infection, third- or fourth-degree perineal tears, or adverse neonatal outcomes in either group. Women in the control group were more likely to have episiotomies (63.6% vs. 0.85%; $p < 0.01$). Three cases of retained placenta were reported in the waterbirth group (0.03%).

Conclusion: Waterbirth at our centre does not appear to be associated with an increased incidence of adverse neonatal and maternal outcomes. The results of this study supported waterbirth as a birthing option to groups of low-risk women in an obstetrician-led setting with good midwifery support.

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Introduction

The first mention of water immersion in labour was in France in 1805, where it was first used to increase maternal relaxation during labour. In the 1960s, Russian obstetricians Tjarkovsky and Leboyer further explored the concept, with a focus on improved neonatal outcomes. It was subsequently popularized by French obstetrician Michael Odent, who published the first research paper in 1983, where he described his experience with 100 waterbirths, which he

personally conducted. He proposed that immersion in the first stage of labour reduced the need for intervention and analgesia [1]. In support of a woman-centred decision making process, the Royal College of Obstetricians and Gynaecologists advocate water immersion as a birthing option that should be offered to healthy women with uncomplicated pregnancies [2]. However, waterbirth is fraught with controversy, as its safety is often questioned by anecdotal case reports of rare, but serious complications associated with waterbirth, such as neonatal drowning, transmission of waterborne infectious diseases, cord rupture, and neonatal (death [3]. A Cochrane review was performed by Cluett and Burns [4] that included 12 randomised control trials, eight of which looked at water immersion in the first stage of labour. Results of the review showed a decreased need for analgesia and duration of labour in

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the immersion group, and no evidence of increased adverse effects to the mother or baby [4]. These findings were corroborated by two other systematic reviews of the literature by Nutter et al [5] and Cordioli [6]. Both reviews showed evidence of benefits in the first stage of labour and no significant increase of adverse maternal or neonatal outcomes [5,6]. Both studies also noted the incidence of umbilical cord avulsion, with Nutter et al [5] quoting a calculated rate of 2.4 per 1000 waterbirths, which has yet to be shown as being significant. On the premise that the existing evidence has yet to demonstrate a clear benefit to mother and baby and the possibility of serious adverse events, the American College of Obstetricians and Gynaecologists (ACOG) released a joint committee opinion paper with the American Academy of Paediatrics in April 2014 stating that water immersion in the second stage of labour, “should be considered an experimental procedure that only should be performed within the context of an appropriately designed clinical trial with informed consent” [7].

More recently, the New England Journal of Medicine (NEJM) wrote a perspective on the National Institute for Health and Clinical Evidence-based review that women with low-risk pregnancies who give birth at home or in midwifery units are likely to have less unnecessary interventions performed on them than if they were to labour in an obstetrician-led unit [8]. In the NEJM review, the postulated reason for this difference was that “obstetricians, who are trained to use scalpels and are surrounded by operating rooms, are much more likely than midwives to pick up those scalpels and use them”, resulting in potential complications associated with these interventions [9]. Waterbirth has long been regarded as a natural method of delivery, with parturients often opting for minimal obstetric intervention in an effort to avoid the associated complications.

In the past decade, the acceptance of waterbirths as an alternative birthing method has extended to Singapore. The National University Hospital (NUH) began offering waterbirths in Singapore in 2006. An upward trend has since been observed in our numbers, and our centre is the largest tertiary hospital conducting waterbirths in Singapore. The ACOG statement release warrants evaluation of our practice. It is also worth looking into the differences in outcomes between a natural method of birthing with minimal interventions and the conventional vaginal delivery conducted at our centre, in light of the NEJM perspective on the high rate of interventions in obstetric units. At NUH, births are conducted in an obstetrician-led hospital setting, with strong midwifery support, continuous foetal heart monitoring, and readily available neonatal care in a bid to weave the merits of a natural birthing process into a system of care where unexpected complications can be dealt with expediently. Existing evidence is largely derived from studies on midwifery-led waterbirths in the West and focused on water immersion in the first stage of labour. Minimal data is available on the conduct of waterbirths in Asia. Chung et al [10] described the factors responsible in influencing the decisions of a group of nine women regarding waterbirths, and Nagai [11] published a case report of *Legionella pneumonia* following a home waterbirth that resulted in neonatal death. This would be the first study describing the unique arrangement of waterbirth in an obstetrician-led unit in an Asian population, specifically during the second stage of labour. The aim of our retrospective study was to compare maternal and neonatal outcomes among women who have had a successful delivery in water with a control group of women with normal vaginal deliveries.

Materials and methods

Data collection

Ethics approval was obtained from the Domain-specific Review Board (DSRB) under the National Healthcare Group, Singapore. This

study was considered under the exempt category, as non-identifiable datasets were used. All deliveries at NUH between January 2010 and December 2013 were reviewed, and women who had a delivery underwater during that time period were included in this study. Each case in the waterbirth group was matched for maternal age, parity (nulliparous or multiparous), and gestational age against controls selected as the next consecutive vaginal delivery within ≤ 30 days of the index case. Data was obtained from central hospital records, into which contemporaneous data was entered following each delivery. The following maternal demographics were collected: date of delivery, patient age, ethnicity, gestational age, parity, presence of antenatal conditions, such as gestational diabetes, Group B Streptococcal infections, and pregnancy-induced hypertension/pre-eclampsia. It was also noted if there was history of a previous caesarean section. Ethnicity was stated as “Others” if women belonged to ethnic groups outside the main ethnic groups found in Singapore (Chinese, Indian, Malay, Caucasian, or Eurasian). Primary outcomes of interest collected were estimated blood loss (EBL), third- or fourth-degree perineal tears, neonatal Apgar scores at 1 and 5 min, and neonatal complications requiring Neonatal Intensive Care Unit (NICU) admissions. Duration of labour was recorded as a secondary outcome of interest. EBL was recorded by the nursing staff following each delivery, according to the guidelines for visual estimation of blood loss proposed by Bose et al [12]. A validated method for visual estimation of blood loss in water was not available; however, this was not thought to affect the accuracy of blood-loss estimation significantly, as women were brought out of the tub immediately after delivering for management of the third stage of labour on land. Taking a mean EBL of 300 mL and an equivalence region of 500mL, it was determined that 130 subjects in each group would have 90% power to demonstrate no difference between both groups.

Waterbirth protocol

Waterbirth is offered as an option at NUH to all women with the following exclusion criteria: (1) transmissible infections (human immunodeficiency virus, hepatitis, syphilis, herpes simplex, viral warts); (2) prematurity (<37 weeks); (3) severe intrauterine-growth restriction; and (4) conditions requiring close intrapartum monitoring, such as severe pre-eclampsia and diabetics requiring insulin infusions. Antenatally, these women attended regular follow-up with a specified obstetrician. According to the local waterbirth policy, the labouring woman was never left alone in the bath pool. On arrival to the delivery suite, all women, regardless of chosen planned-delivery method, were put on continuous cardiotocographic (CTG) monitoring. This is continued for 20 min to ensure foetal wellbeing before the waterbirth protocol was initiated. Women with clinical features suspicious of chorioamnionitis or foetal distress on initial assessment were not permitted to proceed with a waterbirth. Subsequent one-to-one intrapartum care was provided by a dedicated Enhanced Midwifery and Maternity Care midwife or doula according to a prewritten birth plan. Placed on a wireless CTG monitor, which is safe for use in water, women were then allowed to enter the birthing pool at their own comfort and convenience. Water temperature was maintained at between 35°C and 37°C, and the mother was immersed up to chest level. Maternal vital signs were checked every 30 min. Water cleanliness was maintained throughout labour by removal of faecal material and debris using a sieve, with changes of water, if necessary. Vaginal examinations were conducted either in the water using a long, sterile glove or on the bed. In the event of foetal or maternal compromise, women were immediately removed from the water and attended to as per the routine-delivery suite safety protocol. The consultant was updated regularly throughout labour

progression and eventually conducted the vaginal delivery in water. The neonate was immediately brought to the water surface upon delivery. The third stage of labour was then completed out of the water. Given that this study aimed to evaluate water immersion only in the second stage, only women who achieved birth under-water were included. Women who were immersed in water during the first stage of labour, but subsequently did not birth in water, were not included.

Data analysis

Data were entered into a proforma with patient identity masked. All analyses were performed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA), with statistical significance set at $p < 0.05$. Differences in numerical variables were analysed using parametric tests when normality and homogeneity assumptions were satisfied. Otherwise, non-parametric techniques were used. Chi-square or Fisher's exact tests were performed to determine associations among categorical variables.

Results

Demographics

A total of 236 women were included in this study, with equal numbers of women in the waterbirth and control groups (118), and 44.1% of the women were primigravida. Mean maternal and gestational ages were comparable between both groups. Despite a statistically significant difference in mean gestational age ($p < 0.001$) owing to a small standard deviation, this was not thought to affect the results significantly. Ethnic differences between groups were statistically significant, with a larger proportion of Caucasian women in the waterbirth group.

A summary of maternal characteristics are presented in Table 1.

Clinical outcomes

A summary of clinical outcomes are presented in Table 2.

EBL and postpartum haemorrhage

Average values for EBL were similar in both groups. Postpartum haemorrhage (EBL ≥ 500 mL) was observed in three women in the waterbirth group and four women in the control group.

Table 1
Maternal characteristics.

	Waterbirth, n (%)	Control, n (%)	<i>p</i>
Primigravida	52 (44.1%)	52 (44.1%)	1.0
Multigravida	66 (55.9%)	66 (55.9%)	
Mean maternal age (years)	33.6 \pm 3.6	33.6 \pm 3.6	0.802
Mean gestational age (weeks)	39.7 \pm 1.1	39.2 \pm 1.1	0.01
Ethnicity			
Chinese	34 (28.8%)	52 (44.1%)	<0.001
Malay	9 (7.6%)	17 (14.4%)	
Indian	7 (5.9%)	19 (16.1%)	
Caucasian	39 (33.1%)	8 (6.8%)	
Eurasian	3 (2.5%)	1 (0.8%)	
Others	26 (22.0%)	21 (17.8%)	
Antenatal conditions			
GBS	23 (19.5%)	29 (24.6%)	0.1
PIH/pre-eclampsia	1 (0.8%)	6 (5.1%)	
GDM	4 (3.3%)	21 (17.8%)	
VBAC	3 (2.5%)	5 (4.2%)	

GBS = Group B Streptococcal infection; GDM = gestational diabetes mellitus; PIH = pregnancy-induced hypertension; VBAC = vaginal birth after caesarean.

Table 2
Maternal and neonatal outcomes.

	Waterbirth	Normal vaginal	<i>p</i>
Mean EBL, mL (range)	241.4 (223.1–259.5)	241.0 (226.5–255.7)	0.986
Mean duration of labour, min (range)	267.5 (227.4–307.3)	420.7 (371.6–469.7)	<0.05
Perineal trauma, n (%)			
Intact	23 (19.5%)	6 (5.1%)	<0.001
First degree	43 (36.4%)	12 (10.2%)	
Second degree	51 (43.2%)	25 (21.2%)	
Episiotomy	1 (0.8%)	75 (63.6%)	
Third/fourth degree	0	0	
Retained placenta	3	0	0.247
Mean Apgar score at 1 min (range)	8.91 (8.84–8.97)	8.94 (8.85–9.02)	0.542
Mean Apgar score at 5 min (range)	9.00	8.99 (8.97–9.01)	0.318

EBL = estimated blood loss.

Perineal trauma

No third- or fourth-degree tears were observed in either group. Seventy five women (63.6%) in the control group had episiotomies as compared to one woman in the waterbirth group. Correspondingly, women in the waterbirth group had significantly more intact perineums and first- and second-degree tears ($p < 0.001$).

Maternal complications

There were three cases of retained placenta in the waterbirth group as compared to none in the control group. Two of these women required manual removal of placenta under general anaesthesia, and one required a single blood transfusion.

Apgar scores and neonatal complications

No significant difference was found in mean Apgar scores between both groups. Transient tachypnoea of the newborn (TTNB) was reported in four neonates in the waterbirth group and in eight neonates in the control group. All cases of respiratory difficulty resolved within at least 2 h of life with oxygen via a hoodbox, none of which was associated with respiratory tract infections or prolonged hospital stay. There was one NICU admission in the control group for haemolytic anaemia secondary to blood-group incompatibility.

Duration of labour

Mean duration of labour was 267.5 min [95% confidence interval (CI): 227.4–307.3] in the waterbirth group and 420.7 min (95% CI: 371.6–469.7) in the control group.

Discussion

The main finding of this study was that waterbirth at our centre did not appear to be associated with a significant increase in adverse outcomes for mother and baby (postpartum haemorrhage, third-/fourth-degree perineal tears, maternal or neonatal infection); however, an increased number of retained placenta was observed among waterbirth parturients.

Strengths

To date, there has been a paucity of existing literature on obstetrician-led care in the setting of waterbirth since Odent [1] published his series of the first hundred waterbirths which he personally conducted. This is the first study reporting the conduct of waterbirth in Southeast Asia in a unique setting involving an obstetrician-led unit with strong midwifery support. The heterogeneity of literature currently available makes it difficult to draw

definitive conclusions with regard to safety, as factors, including methods of conducting waterbirths, the profile of women who opt for waterbirths, and the experience of the birthing attendant, differ greatly. This study was conducted in a single unit over a relatively short period of time, where practices are not expected to vary greatly.

Limitations

The main limitation of this study involve the small sample size due to the current numbers accrued thus far, which is underpowered for the detection of significant differences in rare, but important clinical outcomes, such as maternal haemorrhage, retained placenta, and perinatal morbidity and mortality. Despite comparisons of outcomes against a group of matched controls, we recognised that elimination of several potential confounders was not possible owing to the retrospective nature of this study. These include maternal ethnicity, pre-existing antenatal conditions (pre-eclampsia, gestational diabetes), and the experience of the healthcare professional conducting the births in each group. EBL values were not available for two women, compromising the completeness of our data.

Interpretation

Perineal trauma

Several studies reported decreased episiotomy rates and higher rates of intact perineums in women who birth underwater, proposing that waterbirth is protective against perineal trauma [13–15]. This is consistent with the high episiotomy rate in the control group observed in this study (64%). It is, however, important to note that all women in the waterbirth group in this study had a written birth plan prior to delivery that opted for minimal interventions, including episiotomies. Conversely, episiotomies at our hospital are performed almost routinely in women (especially nulliparous) delivering vaginally as a protective measure against third- and fourth-degree tears, which could account for this difference. Instead, a more significant finding was that of no third- or fourth-degree tears observed in either group, similar to results of the 2009 Cochrane review, which reported no differences [4]. These results may warrant reassessment of the necessity of performing episiotomies prophylactically in our practice.

Blood loss

In this study, three cases of retained placenta were seen in the waterbirth group; however, this was not associated with a significant difference in EBL and rates of postpartum haemorrhage. This lack of difference between groups was consistent with the results of Menakaya [13]. Although retained placenta was not a commonly cited complication of waterbirths in the literature, it was reported by Odent [1] in two cases out of the first 100 waterbirths performed. This could be explained by the maternal choice for physiological management of the third stage of labour, contrasted with the control group, wherein the third stage was routinely actively managed. However, the incidence of retained placenta in vaginal deliveries has been reported at ~1.4% [16]. The small sample size in this study was, therefore, insufficient to ascertain a true correlation with waterbirths and requires further investigation. However, these results may serve to guide our practice in the use of controlled cord traction and routine oxytocics in the third stage of labour.

Duration of labour

Our findings of reduced labour duration in the waterbirth group were also reported in previous studies [14,17], but were in contrast

with results from a trial conducted by Eckert [18], which reported no difference. However, despite this significant difference ($p < 0.05$), the mean duration of labour was not a primary outcome of interest, as this study was aimed at evaluation of water immersion in the second stage, and, therefore, the use of oxytocics for augmentation or induction of labour was not taken into account.

Neonatal outcomes

Neonatal outcomes were comparable between groups, consistent with results found in a prospective observational study by Geissbuehler [19] that compared 3617 waterbirths against 5901 landbirths, and a surveillance study by Gilbert [20] of 4032 waterbirths that showed no increases in perinatal morbidity and mortality. Results from these studies suggested that rare, adverse events specific to waterbirth that have been quoted, such as freshwater drowning, neonatal hypoxia, transmission of water-borne infectious diseases, cord rupture resulting in neonatal haemorrhage, hypoxic-ischemic encephalopathy, and even neonatal death, may be merely anecdotal and unlikely to happen in our setting. Our finding of higher rates of TTNB in the control group conflicted with a descriptive study by Carpenter [21] that compared 14 waterbirths with 24 conventionally birthed babies admitted for respiratory distress after birth showed that waterbirth was associated with higher levels of respiratory morbidity, and a randomized controlled trial of 274 women by Eckert [20] that showed a higher number of neonatal resuscitations in women immersed in water during the first stage of labour. The findings from our study were unexpected, as it was proposed that waterbirth was associated with delayed lung-fluid clearance in the neonate, and, therefore, should be associated with a higher incidences of respiratory difficulty [3]. However, due to the small numbers used in our study, this may be a false-positive result. Studies involving larger numbers of participants are required to evaluate this outcome (Tables 1 and 2).

Conclusion

While the limitations of this study were significant, these results contributed to the existing evidence that waterbirths are not associated with an increased incidence of serious adverse maternal and neonatal outcomes. Additionally, despite the several obvious differences in approach to delivery between both groups in this study, this did not appear to increase maternal and neonatal morbidity. In view of the proposed maternal benefits of water immersion during labour and a gentler transition environment for the neonate, our findings suggested that waterbirths may not be as fraught with danger as we have been led to think. In support of a woman-centred decision-making process, waterbirth should continue to be offered as an option to women with low-risk pregnancies. Moving forward, plans exist for a prospective cohort study to enable a more robust evaluation of the safety of waterbirths and its association with retained placenta.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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