ORIGINAL ARTICLE

Efficacy of birth ball exercises on labour pain management

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Objectives To evaluate the efficacy of a birth ball exercise programme conducted by physiotherapists on pain relief, psychological care, and facilitation of the labour process at a labour ward in a regional hospital.

Design Case series with before-after comparisons.

Setting Kwong Wah Hospital, Hong Kong.

Participants Chinese women admitted to the labour ward for spontaneous vaginal delivery between April and August 2012 were recruited. Physiotherapists taught birth ball exercises in groups or individually for 30 minutes. Labour pain intensity, back pain intensity, frequency of labour pain, stress and anxiety levels, and subjective pressure level over the lower abdomen were captured before and after birth ball exercises. Most of the parameters were measured using self-reported visual analogue scales. After the exercise session, physiotherapists measured the women's satisfaction level. Midwives recorded pethidine usage.

Results A total of 203 pregnant women participated in this programme; 181 were in the latent phase group, whereas 22 were categorised into the no-labour-pain group. In both groups, there were statistically and clinically significant differences in back pain level, stress and anxiety levels, as well as pressure level over the lower abdomen before and after the exercise ($P<0.05$). In the latent phase group, significant decreases in labour pain and frequency of labour pain were demonstrated. Mean satisfaction scores were high, with visual analogue scale scores higher than 8.2 in both groups. Pethidine usage showed a further decreasing trend (6.4%) compared with the past 2 years.

Conclusion Birth ball exercise could be an alternative means of relieving back pain and labour pain in the labour ward, and could decrease pethidine consumption in labouring women.

A video of birth ball exercise is available at <www.hkmj.org>.

New knowledge added by this study

- Back pain and labour pain can be relieved by 30 minutes of birth ball exercise.
- Physiotherapist-led service of birth ball exercise can decrease pethidine usage in labour wards.

Implications for clinical practice or policy

- Birth ball exercise can be an alternative means for pain relief in labour wards.
- A collaborative service involving midwives and physiotherapists implementing the birth ball exercise programme was highly appreciated and could serve as a model for other hospitals.

Key words
Exercise; Labor pain; Pain management; Parturition; Pregnancy

Hong Kong Med J 2013;19:393-9
DOI: 10.12809/hkmj133921

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Introduction

Pain associated with labour has been described as one of the most intense pains that can be experienced.[1] Effective pain management is crucial in the labour process. In order to relieve pain, pharmacological approaches, such as injection of the analgesic pethidine, are commonly used. Intramuscular pethidine significantly increases sedation scores, dizziness, as well as nausea and vomiting.[2] Under these circumstances, pregnant women commonly feel obliged to remain in bed. Meanwhile, newborns exposed to pethidine have significantly impaired normal behaviour, particularly sucking effort and breastfeeding,[3] as opioids readily cross the placenta and influence fetal-neonatal activity and impair breast feeding.[4] Pethidine is a widely used drug for pain relief in labour and is thus a

生產球運動於陣痛處理的效用

目的 評估物理治療師所推行的生產球運動計劃於紓緩孕婦在陣痛、減輕對生產的焦慮及加快生產過程的效用。

設計 前後比較的病例系列。

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參與者 2012年4月至8月期間於產房選擇進行自然陰道分娩的華籍婦女參與本研究。物理治療師以小組或單對單形式教授孕婦30分鐘生產球運動。運動前後的陣痛強度、腰痛強度、陣痛的頻率、壓力和焦慮水平及主觀下腹壓力強度均被記錄。大部份數據收集都是採用自報的視覺類比量表來評分。完成運動後，物理治療師會測量孕婦對生產球運動的滿意程度。助產士負責記錄止痛藥物配西汀的使用及其份量。

結果 共有203名孕婦參與是項計劃。其中181人被歸類為「潛伏期」組，另22人被歸類為「沒有陣痛」組。在這兩個組別中，運動前後的腰痛強度、壓力和焦慮水平及主觀下腹壓力強度於統計學上和臨床角度上都有顯著差異（$P<0.05$）。「潛伏期」組更表現出陣痛明顯減輕及陣痛頻率明顯下降。兩個組別都十分滿意生產球運動，滿意度平均分均高於8.2。與過去兩年比較，這生產球計劃顯示止痛藥物配西汀的使用呈進一步下降的趨勢（6.4%）。

結論 生產球運動可以於產房作為紓緩陣痛及腰痛的另類方法，亦能減低止痛藥物配西汀的使用。

good representative of pharmacological pain relief requested during labour. Pethidine use and its dosage are well documented in labour records as compared with the more challenging use of Entonox (nitrous oxide + oxygen) [Hong Kong Oxygen, Hong Kong] whose dosages and/or durations of use are difficult to document. Moreover, steady-state concentrations of inhalational agents are almost impossible to achieve during labour, because they are administered intermittently depending on the intermittent nature of pain experienced by the labouring parturient.[5] Thus, modern labour pain management has tended towards non-pharmacological methods. Introducing birth ball exercises into the labour process may help reduce labour pains and decrease resorting to intramuscular pethidine.

Birth ball exercises enhance pelvic rotation and increase the pelvic mobility of pregnant women. The exercise is performed in the upright and sitting positions, which is believed to encourage delivery and support the perineum to facilitate relaxation, and ease labour pain.[6,7]

Stress, anxiety, and fear are the factors contributing to women's perception of pain and affect their labour and birth experience. Birth ball exercises constitute a non-pharmacological means of pain relief, which not only address labour pains, but also attempt to enhance the psychological and emotional components of care.[6,7] Hau et al[8] found that use of birth ball reduced pain and anxiety levels of women in labour. Besides, the duration of the first stage of labour was significantly shorter in their study group.

Physiotherapists have been conducting birth ball exercises in antenatal exercise classes in the Physiotherapy Department of Kwong Wah Hospital, Hong Kong, for the past 9 years. During the last 100 years, more than 630 000 babies were born at Kwong Wah Hospital, which amounts to one in eight infants born in Hong Kong.[9] Over the past decade, the hospital had handled about 6000 deliveries per year. Physiotherapists who specialise in exercise prescriptions are deemed appropriate for teaching birth ball exercises precisely and effectively. To sustain the training effects of the antenatal exercise classes and enhance the effectiveness of birth ball exercises during labour, a collaborative initiative by physiotherapists and midwives at Kwong Wah Hospital commenced birth ball training in the labour ward from April to August 2012. In this context, this physiotherapist-led pilot project in Hong Kong investigated the influence of a birth ball exercise service on pain relief, psychological care, and facilitation of the labour process. In particular, back pain in labour which has not been addressed in previous studies was measured and investigated in this programme.

Methods

Women

Participants for this programme were women admitted to the labour ward of Kwong Wah Hospital from April 2012 to August 2012, with rhythmic labour pains, as well as leaking or bloody shows. The following criteria were used to recruit participants: ability to speak Cantonese, booked with the labour ward in Kwong Wah Hospital, an expectation/plan to undergo spontaneous delivery in Kwong Wah Hospital, and a gestational fetal age between 37 and 41 weeks. Exclusion criteria included women with pre-eclampsia and abnormality in fetal heart rate.

Procedures

Midwives screened suitable participants and obtained verbal consent for birth ball exercises from suitable pregnant women in the labour ward of Kwong Wah Hospital. Physiotherapists gathered basic demographic and clinical information from each participant, explained the rationale of birth ball

exercise, assessed the women's physical condition, and taught birth ball exercises for 30 minutes in groups of six or less women or individually, depending on the number of participants at each session. They conducted the exercises in a room within the labour ward (Figs 1 and 2).

Women were given an option to continue or stop using the birth ball at any time, and other pain relief methods (including drugs) were offered as required. Even after the teaching session, they were encouraged to practise the birth ball exercise whenever they felt like it. The midwives reinforced the instructions after each teaching session, and suggested that all four types of birth ball exercises that had been taught should be practised. The types of birth ball exercises taught were:

1. Sit on birth ball, gently bounce on the ball;
2. Sit on birth ball, tilt the pelvis forward and backward;
3. Sit on birth ball, rock the pelvis in a circular manner; and
4. Kneel down, hug birth ball with arms, rock pelvis back and forth, side to side.

Physiotherapists specialising in exercise prescriptions performed hands-on facilitation to recruit appropriate muscle contractions to maximise the effect of each birth ball exercise.

FIG 1. Types of birth ball exercises taught in labour ward

FIG 2. A physiotherapist teaching birth ball exercise in labour ward

Data collection

The baseline data, such as labour pain intensity, back pain intensity, frequency of labour pains, stress and anxiety levels, and subjective pressure over the lower abdomen were retrieved before commencing the ball exercises. Subjective pressure over the lower abdomen is a mechanical force exerted by the fetus onto the cervix. It can manifest as a subjective increase in pressure over the lower abdomen. This feeling that can occur during the labour process during birth ball exercises may imply fetal descent into birth canal. Except for the frequency of labour pains which is defined by the time interval in minutes between each episode of labour pain, the other parameters were self-reported using visual analogue scales (VASs). The scales consisted of 10-cm horizontal lines from 0 to 10. The least pain scored 0 while the worst scored 10, whereas for patient satisfaction a score of 10 was the best.

After 30 minutes of birth ball exercises, the physiotherapists reassessed the women's condition by determining labour pain intensity, back pain intensity, frequency of labour pains, stress and anxiety levels, and the subjective pressure level over the lower abdomen. The woman's satisfaction level was indicated using the VAS score after the session. The dosage of pethidine used in the labour process was recorded by midwives.

Results

Demographic data

In all, 203 primiparous or multiparous women took part in this service review; none dropped out of the programme. They were categorised into two groups: latent phase (LP) labour pain group (n=181) with pains at intervals of 5 to 20 minutes and cervical dilation of 0 to 4 cm, and the no-labour-pain (NLP) group (n=22) with a pain VAS score of 0 but having had leaking or a bloody show.

In all, 178 (88%) women underwent spontaneous delivery, seven (3%) underwent instrumental delivery, and 18 (9%) had caesarean sections. Ten (5%) women received induction or augmentation.

Whereas there were 2300 women from April to August 2012 who gave birth but did not participate in the birth ball exercises. Among them, there were 1727 (75%) who had spontaneous deliveries, 76 (3%) who had instrumental deliveries, and 497 (22%) who underwent caesarean section; 630 (27%) of these women received induction or augmentation.

Statistical analysis of demographic data in terms of age showed significant difference between two birth ball groups. The mean (standard deviation [SD]) age in the LP and NLP groups were 31.3 (4.4) and 33.6 (3.7) years, with a mean age difference of 2.3 years (P=0.018; Table 1). In terms of parity, in the LP group 117 (65%) were primiparous and in the NLP group the number was 18 (82%).

Baseline data of outcomes

The independent sample *t* test was adopted to compare outcomes (except for labour pain) between two groups. Both stress and anxiety levels before exercise, and pressure level over the lower abdomen before exercise showed no significant difference between the groups. The respective mean (SD) stress and anxiety levels before exercise in the LP and the NLP groups were 5.2 (2.9) and 4.6 (2.9), the mean difference being 0.6 (P=0.297). The respective mean (SD) pressure levels over the lower abdomen before exercise in the LP and NLP groups were 4.3 (2.5) and 3.8 (2.1), the mean difference being 0.5 (P=0.470). The back pain level was the only baseline parameter yielding a significant difference; respective mean (SD) levels before exercise were 4.3 (3.1) and 1.9 (2.1), the mean difference being 2.4 (P=0.008; Table 1).

Outcomes with birth ball exercises during labour

Within each group, paired *t* tests were used to analyse the change of VAS scores before and after birth ball exercises according to their labour pain level, back pain level, frequency of labour pain, stress and anxiety levels, as well as the pressure level over the lower abdomen. All the results including statistical analyses are summarised in Tables 2 and 3. As there was no labour pain in the NLP group, there were no

TABLE 1. Baseline data in the latent phase (LP) and no-labour-pain (NLP) groups

Baseline data	Group	Mean	Standard deviation	*t* Test for equality of means	
				Mean difference	P value (2-tailed)
Age (years)	LP	31.3	4.4	-2.3	0.018
	NLP	33.6	3.7		
Back pain level	LP	4.3	3.1	2.4	0.008
	NLP	1.9	2.1		
Stress and anxiety levels	LP	5.2	2.9	0.6	0.297
	NLP	4.6	2.9		
Pressure level over lower abdomen	LP	4.3	2.5	0.5	0.470
	NLP	3.8	2.1		

TABLE 2. No-labour-pain group paired sample statistics (n=22)

Outcome parameter		Mean	SD*	*t* Test for equality of means	
				Mean difference	P value (2-tailed)
Pair 1	Back pain			0.4	0.027
	Before exercise	1.9	2.1		
	After exercise	1.5	1.8		
Pair 2	Stress and anxiety levels			1.5	<0.001
	Before exercise	4.6	2.9		
	After exercise	3.1	2.0		
Pair 3	Pressure level over lower abdomen			-1.0	0.008
	Before exercise	3.8	2.1		
	After exercise	4.8	2.0		
Pair 4	Satisfaction level after birth ball exercise	8.9	1.0	-	-

* SD denotes standard deviation

scores pertaining to this parameter and its frequency to analyse.

Labour pain level clinically

In the LP group, the mean (SD) labour pain level changed from 5.3 (2.6) before birth ball exercises to 4.3 (2.5) after, the mean reduction being 1.0 (95% confidence interval [CI], 0.8-1.3); the degree of pain reduction was statistically significant (P<0.001; Table 3). There was no labour pain analysis in the NLP group (Table 2).

Back pain level

In the LP group, the mean (SD) back pain level changed from 4.3 (3.1) before birth ball exercises to 3.2 (2.9) after; the mean reduction being 1.1 (95% CI, 0.7-1.4). The pain reduction was statistically and clinically significant (P<0.001). Whereas in the NLP group, the mean (SD) back pain level changed from 1.9 (2.1) before birth ball exercises to 1.5 (1.8) after; the mean reduction being 0.4 (95% CI, 0.1-0.9), the difference was also statistically significant (P=0.027; Tables 2 and 3).

Frequency of labour pain

In the LP group, the mean (SD) frequency of labour pains (time interval in minutes between each episode) changed from 16.1 (32.4) before birth ball exercises to 11.6 (30.8) after; the mean reduction being 4.5 (95% CI, 2.7-6.4). The difference in time interval between each episode was statistically and clinically significant (P<0.001; Table 3). There was no frequency of labour pain analysis in the NLP group (Table 2).

Stress and anxiety levels

In the LP group, the mean (SD) stress and anxiety levels changed from 5.2 (2.9) before birth ball exercises to 3.7 (2.6) after; the mean reduction being 1.5 (95% CI, 1.3-1.8) which was statistically and clinically significant (P<0.001). Whereas in the NLP group, the mean (SD) stress and anxiety levels changed from 4.6 (2.9) before birth ball exercises to 3.1 (2.0) after; the mean reduction was 1.5 (95% CI, 0.9-1.9) which was also statistically and clinically significant (P<0.001; Tables 2 and 3).

Subjective pressure level over the lower abdomen

In the LP group, the mean (SD) pressure level over the lower abdomen changed from 4.3 (2.5) before birth ball exercises to 5.5 (2.3) after; the mean increase being 1.2 (95% CI, 1.0-1.5) which was statistically and clinically significant (P<0.001). In the NLP group, the mean (SD) pressure level over the lower abdomen changed from 3.8 (2.1) before birth ball exercises to 4.8 (2.0) after; the mean increase being 1.0 (95% CI, 0.3-1.7) which was also statistically and clinically significant (P=0.008; Tables 2 and 3).

TABLE 3. Latent phase group paired sample statistics (n=181)

Outcome parameter		Mean	SD*	*t* Test for equality of means	
				Mean difference	P value (2-tailed)
Pair 1	Labour pain			1.0	<0.001
	Before exercise	5.3	2.6		
	After exercise	4.3	2.5		
Pair 2	Back pain			1.1	<0.001
	Before exercise	4.3	3.1		
	After exercise	3.2	2.9		
Pair 3	Labour pain frequency			4.5	<0.001
	Before exercise	16.1	32.4		
	After exercise	11.6	30.8		
Pair 4	Stress and anxiety levels			1.5	<0.001
	Before exercise	5.2	2.9		
	After exercise	3.7	2.6		
Pair 5	Pressure level over lower abdomen			-1.2	<0.001
	Before exercise	4.3	2.5		
	After exercise	5.5	2.3		
Pair 6	Satisfaction level after birth ball exercise	8.3	1.3	-	-

* SD denotes standard deviation

Women's satisfaction level

Both groups showed high satisfaction scores; the mean scores being 8.9 in the NLP group (Table 2) and 8.3 in the LP group (Table 3).

Pethidine usage

In all, 6.4% of the participants used pethidine injections before delivery, which was less than that for all women undergoing delivery in the labour ward in Kwong Wah Hospital (8.0%; Fig 3). However, there was no statistically significant difference in pethidine usage between birth ball users and non-users (P=0.380).

Between-group comparison

Using independent sample *t* test to compare the change in pressure level over the lower abdomen together with change in stress and anxiety levels before and after birth ball exercises demonstrated no significant difference between the two groups.

Discussion

There have been limited studies on the efficacy of birth ball exercises on labour pain management. Physiotherapists teaching these exercises to the pregnant women in the labour ward pioneered the service in Hong Kong. The efficacy of the service was evaluated in various respects, including labour and back pain reduction, anxiety and stress reduction, shortened first stage of labour, decrease in pethidine usage, and women's satisfaction levels.

A few studies reported that birth ball exercises with pelvic movements reduce labour pain.[6,8,10,11] Physiotherapists prescribe birth ball exercises to participants in the sitting and leaning-forward positions, as well as during rocking and with pelvic movements. The results indicated significantly reduced labour pain and back pain. Pregnant women without labour pain but with back pain also benefit from the birth ball exercise.

There was a significant difference in baseline back pain levels between our LP and NLP groups; in the former, the women might not be able to distinguish labour pain from back pain.

Birth ball exercises promote comfort and relaxation, and reduce anxiety.[8] Physiotherapists conduct birth ball exercises in a classroom. This facilitates group dynamics in a relaxed environment away from stressful and disturbing ward areas. The birth ball provides an excellent tool as a firm and comfortable support to sit back on or lean forward with.[7] It cultivates a more enjoyable environment with psychological support within the group and for the physiotherapists. It promotes relaxation and decreases stress and anxiety as demonstrated by our results.

Birth ball exercises facilitate the physiological benefits of movement to help the baby find his or her better fit through the pelvis as labour progresses.[10,11] A systematic review concluded that positioning and movements in labour are recommended as a means of rotating a malpositioned fetus and correcting slow progress in dilation or descent.[12] Hau et al[8] found that birth ball exercises shortened the duration of the first stage of labour. The results also revealed that the pressure level over the lower abdomen and the frequency of labour pain increased after 30 minutes of birth ball exercises. This implied a better fit of the fetal head through the pelvis.

Despite increased frequency of labour pains, subjectively the women rated decreased levels of pain. This phenomenon can be due to birth ball exercises promoting comfort and relaxation, which can build a woman's confidence to cope with pain, thus maintaining a sense of mastery and wellbeing instead of passive compliance. Birth ball exercises encompass the psycho-emotional and spiritual components of care.[6]

Women appreciated this service with a high level of satisfaction. The group without labour pain scored even higher than the LP group. They were delighted to perform birth ball exercise to occupy their 'waiting' time for delivery and in so doing gained psychological support from the class.

Physiotherapists specialised in exercise therapy and pain management introduce birth ball exercises in labour wards to extend the scope of physiotherapy in obstetric units and provide an alternative means for pain relief. The results demonstrate that pethidine

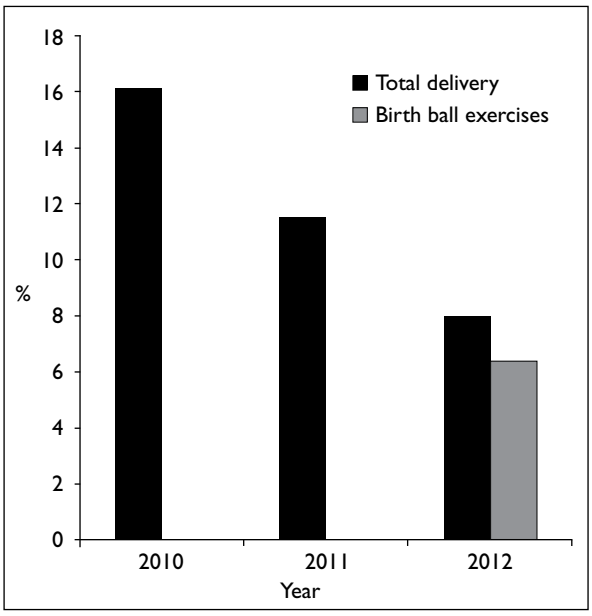

FIG 3. Percentage of pethidine used in labour ward of Kwong Wah Hospital

usage decreased significantly after this service was launched. Compared with figures in the past 2 years, there was a further drop in the decreasing trend in pethidine usage (2010: 16.1%; 2011: 11.5%; 2012: 8.0%; Fig 3). However, there was no statistically significant difference in pethidine usage between birth ball users and non-users. The small sample of 13 birth ball users compared with 171 non-users could hardly demonstrate statistical significance based on the Chi squared test.

Both groups of women benefited from birth ball exercises in terms of stress and anxiety level reductions, increased subjective pressure level over the lower abdomen, and back pain reduction. Hence, birth ball exercises should not be confined to women with labour pain. They can also be of use for the women without labour pain in the labour ward.

This service review did not intend to compare all the existing pain relief methods. In the future study, in addition to pethidine, other modalities such as Entonox (nitrous oxide + oxygen) and epidural analgesia could also be considered. The duration of the first stage of labour can also be captured in any future study, as could the duration and frequency of exercise on outcomes. This was not a randomised controlled trial and therefore had many limitations due to potential selection and information biases.

Conclusion

This service programme demonstrated efficacy of birth ball exercises in terms of reducing labour pain and back pain, decreasing anxiety levels, and promoting relaxation. Such exercises could be an alternative means of pain relief in labour wards. This collaborative programme was highly appreciated by recipients of the service, as well as medical and midwifery staff in the labour ward in Kwong Wah Hospital. Future enhancement of this programme by extending the service hours of physiotherapy services and exploring the possibility of a randomised controlled trial deserve exploration.

Acknowledgements

Special thanks to Elva Ng, Sandy Chan and Claudia Sit who contributed to data collection and conducting birth ball exercise class. SM Tai and her midwife team in the labour ward are acknowledged for collaboration and data collection.

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