ORIGINAL ARTICLE

# Comparison between using an Automatic Uterine Massage Machine and manual uterine massage on postpartum blood loss within two hours after delivery at labour room, Phramongkutklao Hospital

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## ABSTRACT

This experimental study compares the effectiveness of Automatic Uterine Massage Machine (AUMM) and Manual Uterine Massage on uterine contraction intensity and the amount of postpartum blood loss within two hours after delivery. The participants consisted of 60 postpartum women who were within 2 hours of their normal delivery at Phramongkutklao Hospital, Bangkok, Thailand. The experimental and comparison groups each consisted of 30 participants allocated by a simple random method when visiting the labour room. The comparison group received a manual uterine massage by a nurse, while the experimental group received AUMM. Both groups received standard postpartum care, which included assessment for postpartum hemorrhage, administration of oxytocin 10 units, and ensuring an empty bladder. Mann-Whitney U test was used to analyze the difference in uterine contraction intensity and amount of postpartum blood loss between the groups. The participants' characteristics between the groups revealed no statistically significant differences ($p > 0.05$). The manual uterine massage group exhibited significantly stronger uterine contractions compared to the AUMM group ($p < 0.001$). The key findings indicated that there was no significant difference in the amount of blood loss during the first 2 hours after delivery between the two groups ($p = 0.323$). Although using AUMM resulted in a significantly lower uterine contraction intensity, the amount of postpartum blood loss was not significantly different compared to the manual uterine massage group. Therefore, AUMM could be an alternative to manual uterine massage, especially in healthcare facilities facing a shortage of nursing staff, particularly during the critical period of the first 2 hours after delivery.

**Key words:**
postpartum blood loss; postpartum women; Automatic Uterine Massage Machine

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# INTRODUCTION

Postpartum hemorrhage (PPH) persists as a significant contributor to maternal mortality, even in developed countries. In developing countries, current maternal mortality rate attributable to PPH stands at approximately 1 in 1,000.[1] According to the World Health Organization (WHO) report[2], PPH is a leading cause of maternal mortality in numerous nations, including Thailand.[3] PPH can result from various causes, including uterine atony, uterine rupture, cervical tears, retained placenta, and abnormal coagulopathy. The consequences of PPH are severe conditions such as Sheehan syndrome, which is postpartum pituitary necrosis[4], resulting in a diminished quality of life and can even be fatal.[5] Therefore, the prevention of PPH is crucial in postnatal care, aiming to mitigate complications and reduce maternal mortality rates.

Seventy percent of PPH cases are attributed to inadequate uterine contractions (uterine atony).[5] As a preventative measure, the 26th edition of Williams Obstetrics advocates for the immediate massage of the uterus following childbirth.[5] The American College of Obstetricians and Gynecologists (ACOG)[6] and WHO[7] recommend assessing blood loss and uterine contractions, while Erkaya[8] and Lalonde[9] emphasize the importance of immediate massage after childbirth, repeated at 15-minute intervals within the first two hours postpartum. Failure in achieving optimal uterine contraction significantly heightens the risk of substantial bleeding.[10] A proper massage technique facilitates effective uterine contractions, thereby minimizing the vulnerability to PPH.[5] Therefore, uterine massage is an essential care to perform immediately after childbirth.

Most postpartum mothers are fatigued, most likely sleeping, and unable to perform self-uterine massages within 2 hours after childbirth.[5,12–15] Therefore, it is the nurse's responsibility to massage the uterus every 15 minutes. Moreover, nurses must ensure that mothers do not have a full bladder, as this can impede uterine contractions.[11] However, challenges arise due to constraints in staffing and demands of attending to multiple deliveries and postpartum mothers awaiting care, potentially leading to delays in manual uterine massage intervention, increasing the risk of PPH.[16]

Nowadays, technology has significantly improved maternal care and several innovations have shown beneficial impacts on optimizing the quality of maternal and newborn care.[17] Therefore, to tackle the challenges of inadequate uterine massage, researchers have developed an innovative solution: the Automatic Uterine Massage Machine (AUMM). Only innovations employing alarms to prompt uterine massage have been identified[5,12–14], with a notable absence of devices capable of automatically performing massages as a substitute for nurses or postpartum women. This innovation serves as a viable substitute aid for healthcare professionals and mothers, ensuring timely uterine massage at 15-minute intervals, consequently aiming to prevent PPH. The AUMM has been designed with user-friendly features, allowing easy installation by placing it on the mother's fundus immediately after placenta delivery. The machine's mechanism allows users to set specific massage timing, massaging every 15 minutes for 2 minutes each round, and continuously operating for 2 hours. This innovation aims to enhance the efficiency of postpartum care, especially in settings with limited healthcare professionals to deliver timely and consistent uterine massage for preventing PPH. The research

aims to compare the effectiveness of manual uterine massage and the AUMM against the amount of postpartum blood loss within the first two hours after childbirth.

***Hypothesis***

There is no difference in the amount of blood loss within the first two hours after delivery between AUMM and manual uterine massage.

## METHODS

This research employed an experimental design across a population of postpartum women who had a normal delivery at term (37-42 weeks of gestation), at the labor room of Phramongkutklao Hospital, Bangkok, from September 2022 to March 2023. The inclusion criteria focused on postpartum mothers aged between 20-35 years, with a pre-pregnancy Body Mass Index (BMI) < 25 kilograms per square meter ($kg/m^2$), experiencing their 1st to 3rd pregnancies, and without complications during pregnancy and delivery. Participants should be willing to participate and able to understand and speak Thai. Convenient sampling, a non-probability sampling method, was used to enroll participants into the study as they arrived at the labour room, and then a simple random method was used to allocate the participants into the two groups. The comparison group received manual uterine massage administered by a nurse, and the experimental group received AUMM. Although blinding can minimize performance and detection biases, blinding was not obtained at all stages in this study due to the limitation of the intervention evaluated. Participants who developed postpartum complications such as high blood pressure or excessive bleeding after delivery were excluded from the study.

The sample size was determined using Power Analysis. The Effect Size (ES) was calculated from a similar prior study by Hayibueraheng[12], where the ES was found to be 3.96. This value was considered a large ES (0.80) based on the Cohen ES index value.[18] G*Power version 3.1 was used to calculate the sample size by applying a large power level of 0.80, with a significance level of 0.05, and a large ES of 0.80. Each group consisted of 26 participants. To mitigate the effect of the sample dropping out, 15 percent more participants were added to each group, resulting in 30 participants in each group with a total sample size of 60 participants.

***Research Procedure***

Experimental Group: The AUMM was placed on the abdomen at the uterine fundus after placental delivery. The machine was set to massage for 2 minutes, followed by a 15-minute break, and the cycle was repeated for a total of 2 hours after placental delivery.

Comparison Group: Nurses provided manual uterine massage to the participants, massaging every 15 minutes for a total of 2 hours after placental delivery.

Routine postpartum care, including assessing postpartum hemorrhage, administrating uterotonic agents (Oxytocin 10 units), and ensuring an empty bladder was administered by the attending nurse in both groups. To assess blood loss, measurements were taken every 15 minutes and the weight of the pads used during the entire 2-hour period was recorded.

***Outcome Measurement***

Uterine contractions intensity was measured on a scale of mild, moderate, and strong[26], by trained medical professionals with a minimum of 5 years of experience and who were not involved in the research. At least two observers were involved in assessing uterine contraction intensity after uterine massage in both groups.

Postpartum blood loss within the first 2 hours after childbirth was measured by weighing the pads on the digital scale[19],

recording the weight at the end of two hours after delivery, and converting it to milliliters (1 gram = 1 milliliter).[19] The actual blood loss was calculated by subtracting the weight of the unused pad (16 grams/pad) from the total weight of the used pads.

Minimizing performance and detection bias involves training assessors to ensure they remain unbiased in their assessment of outcomes. Although blinding was limited in this study, strategies for training assessors were utilized. The inter-rater reliability of uterine contraction intensity assessment was performed using the Intraclass Correlation Coefficient (ICC), which was at 0.80 *(p* <.01). This included a training workshop on research procedures and outcome measurement for qualified assessors. Moreover, a data collection form indicating the timing of evaluation was used to ensure the protocol's reliability.

***Statistics***

Demographic data were analyzed using descriptive statistics. The normality test (Shapiro-Wilk) was employed to assess whether all variables met the criteria of normal distribution. The independent t-test was used to compare the demographic data between the two groups due to the data's normal distribution. The non-parametric test (Mann-Whitney U test) was used to compare the uterine contraction intensity and postpartum blood loss between the groups due to the data's skewed distribution.

***Research Ethics***

This research project has been approved by the Institutional Review Board of the Royal Thai Army Medical Department (IRBRTA 789/2556 dated June 11, 2022). Participants have the right to withdraw from the study at any time without any consequences. All data collected will be kept confidential and will not cause any harm to the participants. The safety protocol was used in this study in case of the occurrence of any adverse event, however, there were no adverse events reported in this study.

# RESULTS

The demographic data of 60 participants (Table 1) showed that the average age was 28.26 ± 4.70 years. The majority were multiparous accounting for 51.67%. The most gestational age was 38 weeks (41.70%), and the average pre-pregnancy BMI was 20.83 ± 2.18 kg/m². The average birth weight was 2,980 ± 387.63 grams. All participants were administrated oxytocin 10 units. The demographic data was normally distributed. The data revealed that there were no statistically significant differences ($p$ > .05), indicating that the two sample groups were similar.

**Table 1.** Demographic data of participants (N = 60)

| Characteristics | AUMM (n=30) | | Manual Massage (n=30) | | Total (N=60) | | *t* | *p-value* |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | | |
| Age | 28.13 | 4.97 | 28.40 | 4.49 | 28.26 | 4.70 | -.218 | .828 |
| Gestational Age | 38.80 | 0.80 | 38.56 | 0.77 | 38.68 | 0.79 | 1.144 | .257 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pre-pregnancy BMI | 20.39 | 2.29 | 21.27 | 2.00 | 20.83 | 2.18 | -1.573 | .121 |
| Birth Weight | 3000.80 | 440.53 | 2959.06 | 332.75 | 2979.93 | 387.63 | .414 | .680 |
| Gravida (N, %) | | | | | | | | |
| Primigravida | 15 | 50% | 14 | 46.67% | 29 | 48.33% | | |
| Multipara | 15 | 50% | 16 | 53.33% | 31 | 51.67% | | |

Significant level of *p* value < 0.05, N = number of participants, M = Mean, SD = Standard deviation,
Statistical analysis: Independent t-test

The data on uterine contraction intensity (Table 2) exhibited a skewed distribution, and a non-parametric test was used to analyze the difference between the groups. The result showed that the two sample groups had statistically significant differences in levels of uterine contraction intensity ($p < .001$). In the experimental group utilizing the AUMM, the assessment indicated varying levels of uterine contraction intensity, ranging from moderate (33.33%) to strong (66.67%). In the comparison group, the level of uterine contraction intensity was consistently rated as strong across all participants.

**Table 2.** Comparison of uterine contraction intensity (N=60)

| **Outcome** | **AUMM (n=30)** | | **Manual Massage (n=30)** | | **Total (N=60)** | | ***p-value*** | **Effect Size** |
|---|---|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **N** | **%** | | |
| Uterine Contraction Intensity | | | | | | | | |
| Mild | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | <.001 | .144 |
| Moderate | 10 | 33.33 | 0 | 0.00 | 10 | 16.67 | | |
| Strong | 20 | 66.67 | 30 | 100.00 | 50 | 83.33 | | |

Significant level of *P* value < 0.05, N = number of participants
Statistical analysis: Mann-Whitney U Test
Effect Size: Rank biserial correlation

The results (Table 3) revealed no statistically significant differences in the amount of postpartum blood loss within two hours after delivery between the two groups ($p > .05$). The experimental group, utilizing the AUMM, exhibited slightly less than average blood loss (53.20 ml) when compared to the group who received manual uterine massage (53.47 ml).

**Table 3.** Comparison of postpartum blood loss (N = 60)

| Outcome | AUMM (n=30) | | Manual Massage (n=30) | | Total (N=60) | | *p-value* | Effect Size |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | | |
| Postpartum blood loss (ml/2 hours) | 53.20 | 1.44 | 53.47 | 1.53 | 53.31 | 1.51 | .323 | .333 |

Significant level of *p* value < 0.05, N = number of participants, M = Mean, SD = Standard deviation,
Statistical analysis: Mann-Whitney U Test
Effect Size: Rank biserial correlation

## DISCUSSION

This study examined the postpartum blood loss and uterine contraction intensity in the first two hours after delivery in postpartum mothers, comparing the use of AUMM and manual uterine massage. The findings could serve as the protocol for postpartum nursing care[21,25].

The study's findings demonstrated that there was no significant difference in the amount of blood loss within the first 2 hours after delivery between using AUMM and manual uterine massage ($p > 0.05$). The result aligns with the hypothesis of this study, which is that there is no difference between the amount of blood loss within the first 2 hours after delivery between the groups. None of the postpartum mothers in either group experienced early PPH (defined as blood loss exceeding 500 milliliters within the first 2 hours postpartum).[2] Utilizing the AUMM resulted in slightly less average blood loss (53.20 ml), compared to manual uterine massage (53.47 ml). This difference might not be of considerable clinical significance, however, the use of AUMM could standardize the quality and equality of postpartum care to prevent PPH, especially in limited resource settings. This finding suggests that both AUMM and manual uterine massage were equally effective in preventing PPH within 2 hours after placental delivery and could be used interchangeably in caring for postpartum mothers with characteristics similar to the population in this study. Although there are no studies examining the effectiveness of an innovation in performing uterine massage, various studies of innovations employing alarms to prompt uterine massage have been identified. The findings showed the benefits of regular uterine massage to prevent PPH after childbirth.[5,12–14]

In terms of uterine contraction intensity, the findings indicated a statistically significant difference ($p < 0.001$) in the levels of uterine contraction intensity between the two groups. The manual uterine massage group exhibited a strong level of uterine contraction intensity, while the group using AUMM showed a moderate to strong level of uterine contraction intensity. Characteristics such as age, parity, pre-pregnancy BMI, that might lead to inadequate uterine contraction[27], were not different between the groups, therefore the differences in uterine contraction intensity might derive from the inability of AUMM to reach deep or exert sufficient force in cases where postpartum mothers have a thick abdominal wall. Furthermore, AUMM cannot adjust the massage level according to the level of

uterine contraction intensity. Nevertheless, the amount of blood loss did not differ between the groups, despite variations in uterine contraction intensity.

Oxytocin administration is recommended as part of routine active management in the third stage of labor as it increases uterine contraction and reduces blood loss.[24,25] All participants in both groups were administered 10 units of oxytocin, which might be a factor impacting uterine contractility and postpartum blood loss after delivery in this study.

The study findings emphasize the importance of postpartum uterine massage and the application of innovation to optimize the quality of maternal care. The uterine contractility can ensure postpartum hemostasis in the fourth stage of labor.[28] Many studies have shown that postpartum uterine massage serves both preventive and therapeutic purposes for PPH.[2,6,8,9,20,22] ACOG[6] and WHO[2] also recommend immediate massage of the uterus after childbirth to prevent PPH. Moreover, this is a part of active management of the third stage of labor, aiming to prevent PPH.[16,21] The Cochrane Review and Meta-analysis comparing uterine massage and control groups indicated that a smaller number of the participants experienced blood loss of more than 500 ml in the uterine massage group.[16] Moreover, statistically significant differences were observed in the average blood loss within 30 minutes postpartum (Mean Difference (MD) -41.60 ml, 95% CI -75.16 to -8.04) and within 60 minutes postpartum (MD -77.40 ml, 95% CI -118.71 to -36.09), favoring the uterine massage group.[16] Additionally, there was a statistically significant decrease in the need for uterotonic drugs in the uterine massage group (RR 0.20, 95% CI 0.08-0.05).[22,23]

## LIMITATIONS

The specific inclusion criteria caused difficulties in the recruitment of participants during data collection. This non-parametric test may pose limitations to the generalizability of the study's findings. Moreover, the convenient sampling employed could introduce selection bias, while unblinding might lead to a risk of detection bias, thereby exerting an impact on the study's internal validity. Therefore, application of the findings needs to consider participants who are similar to the sample group in this study. AUMM could also be developed to ensure the ability to exert sufficient force in cases where mothers have a thick abdominal wall, as well as the ability to adjust the massage level according to the level of uterine contraction intensity.

## RECOMMENDATIONS

The use of the AUMM within 2 hours postpartum showed no significant difference in the amount of blood loss compared to manual uterine massage. Therefore, the AUMM can be used as a substitute for manual uterine massage. This is particularly beneficial in resource-constrained settings facing a shortage of nursing personnel to care for postpartum mothers, especially during the critical 2-hour period post-delivery when the risk of PPH is high. However, applying the AUMM to a wider population needs consideration of the similarity to the participants in this study, who are low-risk postpartum mothers. Furthermore, studies involving diverse population groups, such as high-risk postpartum mothers, are needed to ensure the applicability of the AUMM in a broader clinical practice, in line with developing the innovation to enhance the effectiveness and usability for a broader range of postpartum mothers.

## CONCLUSION

In summary, employing the AUMM in the initial 2 hours following childbirth did not yield notable differences in

postpartum blood loss when compared to manual uterine massage. Therefore, AUMM can be used as a substitute for manual uterine massage, despite inducing uterine contractions of moderate to strong intensity. This is particularly advantageous in resource-constrained healthcare settings facing nursing staff shortages, especially during the first 2 hours post-delivery, a period associated with elevated postpartum bleeding risks. However, consideration of the similarity to the participants in this study needs assessment when applying the AUMM to a wider population.

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