Original Article

Comparison of the effect of web-based, simulation-based, and conventional training on the accuracy of visual estimation of postpartum hemorrhage volume on midwifery students: A randomized clinical trial

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ABSTRACT

Introduction: Delay in diagnosis of bleeding can be due to underestimation of the actual amount of blood loss during delivery. Therefore, this research aimed to compare the efficacy of web-based, simulation-based, and conventional training on the accuracy of visual estimation of postpartum hemorrhage volume. **Materials and Methods:** This three-group randomized clinical trial study was performed on 105 midwifery students in Mashhad School of Nursing and Midwifery in 2013. The samples were selected by the convenience method and were randomly divided into three groups of web-based, simulation-based, and conventional training. The three groups participated before and 1 week after the training course in eight station practical tests, then, the students of the web-based group were trained on-line for 1 week, the students of the simulation-based group were trained in the Clinical Skills Centre for 4 h, and the students of the conventional group were trained for 4 h presentation by researchers. The data gathering tool was a demographic questionnaire designed by the researchers and objective structured clinical examination. Data were analyzed by software version 11.5. **Results:** The accuracy of visual estimation of postpartum hemorrhage volume after training increased significantly in the three groups at all stations (1, 2, 4, 5, 6 and 7 ($P = 0.001$), 8 ($P = 0.027$)) except station 3 (blood loss of 20 cc, $P = 0.095$), but the mean score of blood loss estimation after training did not significantly different between the three groups ($P = 0.95$). **Conclusion:** Training increased the accuracy of estimation of postpartum hemorrhage, but no significant difference was found among the three training groups. We can use web-based training as a substitute or supplement of training along with two other more common simulation and conventional methods.

Key words: Accuracy, postpartum hemorrhage, training, visual estimation

INTRODUCTION

Postpartum hemorrhage is one of the major causes of maternal mortality worldwide.[1,2] A woman dies every 4 min because

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of postpartum hemorrhage.[3] The incidence of postpartum hemorrhage is reported to be 2–4% in normal delivery and 6% in cesarean section.[4] Typically, postpartum hemorrhage refers to blood loss of 500 mL or more after completion of the third stage of labor.[5,6]

Delay in diagnosis and management of postpartum hemorrhage can cause many complications such as severe anemia, blood transfusion and its complications, disseminated intravascular coagulation (DIC), Sheehan's syndrome, hysterectomy, and death.[7-9] Delay in diagnosis of bleeding can be due to underestimation of the actual amount of blood loss during delivery. Visual estimation of bleeding is one of the methods of the postpartum hemorrhage evaluation.[10] Visual estimation of bleeding is a rapid and noninvasive method.[11] Studies have shown that caregivers estimate the blood volume based on their self-notion.[12] The accuracy of visual estimation of blood loss can be increased by standardization of visual estimation of blood loss and training the observers in these areas.[13]

Akhlaghi *et al.* (2012) showed that the estimation of postpartum hemorrhage volume by healthcare staffs was not accurate and training them to improve their skills of the estimation of postpartum hemorrhage seems to be necessary.[14] Further, Shafi *et al.* (2006) demonstrated that health caregivers are unable in visual estimation of postpartum hemorrhage volume and need to be trained in this area.[12] A midwife is often the first person who is present at the time of bleeding.[4] Therefore, efforts to improve the quality of midwifery training play a decisive role on the health of the society and quality of patient care.[15]

Achieving this goal will obviously require a complete and comprehensive education system. Today, training in our country is offered more in conventional methods and by lecture using PowerPoint. The majority of the students are inactive and do not have the experience of active learning environment. Therefore, alternative methods and using the methods through which students gain the knowledge and skills are needed.[16] The use of the methods based on personal learning has the greatest and most important effect.[17] These methods include learning by the use of simulators in small groups by practicing on a model in the clinical skills training center, and using CDs and multimedia.[18] By providing simulators and models, simulation-based training creates an opportunity for the students to learn the communication and technical skills in a calm and guided environment before entering the clinical area and gaining the clinical competence.

Because the number of students and the volume of skills required for the students are high, the opportunities for learning are low for them, hence, the use of multimedia enabled teaching approaches, which uses different methods of teaching, seems to be useful.[19] One of these approaches is self-directed learning methods such as web-based training.[18] Web-based training increases the rate of training and learning, and each student uses the available resources according to his individual potentiality. Despite the unique advantages and opportunities that web-based training has provided, but like any emerging phenomenon it is encountered with some challenges and limitations, especially in developing countries.[20] The disadvantages of this type of education are its cost, the lack of direct interaction between teachers and students, the lack of face-to-face learning, which causes feeling of isolation among the students, and an negative impact on their success rate in the courses.[21]

Toledo *et al.*, (2010) showed that there were no difference between web-based training and face-to-face training in terms of accuracy of estimation of postpartum hemorrhage volume.[22] Due to the importance of accuracy of estimation of postpartum hemorrhage volume by midwifery students who are future midwives, appropriate high quality teaching methods to train the students for achieving the skills of visual estimation of postpartum hemorrhage volume, and also the lack of enough studies in Iran, the researcher aimed to compare the efficacy of web-based, simulation-based, and conventional training on the accuracy of visual estimation of postpartum hemorrhage volume in the midwifery students of Mashhad Nursing and Midwifery School.

MATERIALS AND METHODS

This is a three-group randomized trial that was performed after obtaining approval from the Ethics Committee of Mashhad University of Medical Sciences. The sampling started with a written introduction letter to the Mashhad School of Nursing and Midwifery in 2013. We calculated the sample size based on a pilot study based on the formula of proportions.

With parameters $\alpha = 0.05$; $1 - \beta$ (or power) $= 0.80$, CI: 95%, P_1: 0.71, P_2: 0.37, 30 participants were needed in each group. Expecting that 15% of the recruited participants could be ineligible for the final analysis, we concluded that each group should consist of at least 35 participants. The total number of students eligible for entry to the study was 105 cases. To minimize the effects of other variables and further homogenization, the samples were selected randomly in each semester and were randomly divided into three groups by the table of random numbers. Numbers 1–3 were assigned to each group and when the right figure of the selected number was similar to the code, that person was allocated to the related group, and in the case of no similarity of right figure, the figure of second, third, or fourth have been the criteria. Observers and statistical analyzers did not know how participants were randomly allocated in the three groups that were conducted. Inclusion criteria including rejection of guests or transited students, consent to participate in the study, and unpleasant events within previous 6 months. Exclusion criteria were not participating in all phases of training such as absence in pretest, training session, post-test, Internet disconnection and testing, and unfortunate occurrences such as death of one degree relatives, severe family disagreements, and financial problems, during training sessions and test period. At the beginning of the study, each group included 35 cases,

but during the course of the study, one case of the web-based group and four cases of the conventional group were excluded due to lack of participation in the post-test [Figure 1]. Then, the researcher introduced himself and explained a brief description of the study. If the students had willingness to participate in the study, the informed consent form and the form for selecting the study units were completed through an interview.

Data were collected by the researcher-made questionnaire of demographic characteristics and an objective structured clinical test. After completing the demographic questionnaire, the objective structured clinical pre-test was given to the students. The demographic characteristics questionnaire included age, status of residence, semester, marital status, work experience, and self-assessment of skill of estimation of postpartum hemorrhage volume (was measured by Likert 5 option: Very high, high, average, low, very low, and any) that its validity was evaluated by the method of content validity. The objective structured clinical test contained eight stations: Station No. 1, sterile gauze 10 × 10 stained to 10 cc blood; Station No. 2, pad stained to 10 cc blood; Station No. 3, pad stained to 20 cc blood; Station No. 4, sterile gauze completely stained to 60 cc blood; Station No. 5, large receiver containing 500 cc blood; Station No. 6, clot with volume of 40 cc blood; Station No. 7, pad under the patient stained to 350 cc blood, and Station No. 8, patient's bed stained to 1000 cc blood that was simulated in situations such as postpartum hemorrhage in the maternity and was reconstructed in the clinical skills center. The students just had to estimate the blood loss volume in a numerical and recorded in a form that the observer had provided for them and gave it to the observer before exiting the station. The observer had no information on allocation of persons to the studied groups. Scenes of postpartum hemorrhage were reconstructed in the objective structured clinical test by using a graded syringe that is a valid tool and synthetic blood that has similar density of blood. The minimum score of zero and maximum score of one were obtained from each station, as the minimum score of the bleeding volume was zero and the maximum was eight. The total time of the objective structured clinical test for each individual lasted 8 min. Training began from the day after pretest. The same educational content was offered in all the three groups based on national guideline providing obstetric services in loving mother hospitals and various methods of estimation of postpartum hemorrhage volume. In the conventional training group, educational materials as lectures with PowerPoint and a training film for 4 h (two sessions of 2 h, from 8 am to 12 pm in nursing and midwifery school, Mashhad) were presented by the researcher. In the simulation-based group, at first, a brief summary of the educational content as lectures, PowerPoint, and a training film was explained for 45 min in the clinical skills center. Then, the researcher poured different volumes of bleeding (10, 20, 30, 40, 60, 80, 100, 250, 350, 500, and 1000 cc) on the pad and showed the method of estimation of bleeding volume with different methods (based on the amount of bleeding, symptoms, visual, weighing, testing, and blood collection plastic bags) (total time of training was 4 h).

In the web-based group, 1-h training on how to use educational website[1] that contains educational researcher

[1] http://schools.mums.ac.ir/sites/nurse

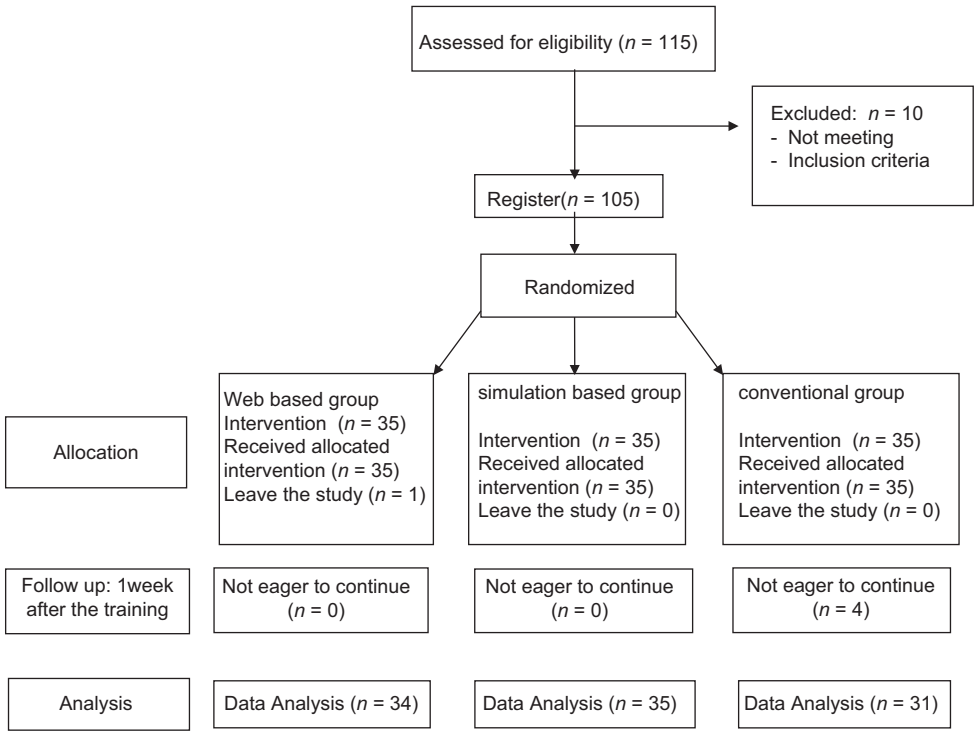

Figure 1: CONSORT flow chart of participants

estimates, the volume of postpartum hemorrhage was taught, and username and password to the students in this group were given. After that, students had access to the website for 1 week. After a week, username and password were out of date and students were no longer able to access educational content. Before the inception of study, the researcher together with cameraman took photos of different volumes of blood loss (10, 20, 30, 40, 60, 80, 100, 250, 350, 500 and 1000 mL) in different containers and different materials such as pads and made a film of 1 h about how to estimate blood loss volume by different methods (on the basis of the amount of blood loss, visual signs, weight, tests, and plastic bag for collecting the blood). After revision of images and didactic film, they were uploaded on the website. During this time, the students contacted the researcher via email (asynchronous) or in person and asked their questions. The person who designed the website checked the online system to ensure that the system will not be disconnected during the training period. Again, 1 week after the training sessions, the post-test was simultaneously given to all the three groups just as the pre-test. The pre- and post-test results were compared in the three groups by descriptive statistical tests, χ^2, Wilcoxon, a two-way ANOVA analysis, and SPSS software 11.5. $P < 0.05$ was considered statistically significant.

RESULTS

The total number of students eligible for entry to the study was 105 participants, and 100 participants completed the study and were included in the analysis [Figure 1]. The mean and SD of age were 24.97 ± 5.44 in the students of the web-based group, 24.42 ± 4.44 in the simulation-based group, and 25.63 ± 4.95 in the conventional group. The mean and SD of the working experience was 2.03 ± 4.08 years in the students of the web-based group, 1.02 ± 1.66 in the simulation-based group, and 1.16 ± 1.63 in the conventional group. Further, 29.41% of students in the web-based group, 51.42% of the simulation-based group, and 51.61% of the conventional group were living in the dormitory. The three groups were similar in terms of these three variables: Age ($P = 0.622$), working experience ($P = 0.531$), and residence ($P = 0.277$). The three groups were not statistically different in terms of course and education semesters, marital status, and self-assessment skill of estimation of postpartum hemorrhage volume [Table 1].

The mean score of estimation of postpartum hemorrhage volume before and after training showed significant differences in the three groups ($P < 0.001$). The Kruskal–Wallis test showed that there was no significant difference between the three groups in terms of the mean score of estimation of postpartum hemorrhage volume before ($P = 0.327$) and after training ($P = 0.95$) [Table 2].

Accuracy of estimation of postpartum hemorrhage volume at station No. 1, 2, 4, 5, 6, 7, and 8 was significantly different before and after training in the three groups ($P < 0.05$), but at station No. 3, there was no significant difference in the three groups before and after training ($P = 0.095$) [Table 3].

Two-way ANOVA results showed that the marital status, course and education semester, and self-evaluation of the skill of estimation of postpartum hemorrhage volume was not significantly associated with the estimation of postpartum hemorrhage volume ($P > 0.05$) [Table 4].

DISCUSSION

The findings of this study showed that the accuracy of visual estimation of postpartum hemorrhage volume in bleeding volume <350 cc (except station No. 4 gauze fully stained with the 60 cc blood) is higher than the actual volume of blood loss, and in bleeding volume >350 cc (except station No. 5 receiver with 500 cc blood) is less than the actual volume of blood loss and the results are in agreement with the previous studies.[13,23,24]

Razavi's study found that the visual estimation of low blood loss tends to be overestimated and vice versa, that is, the visual estimation of high blood loss tends to be underestimated.[24]

In this study, visual underestimation at Station No. 4 may be due to the misconception of students from low level of staining of gauze 10 × 10 with blood, and the visual overestimation at station No. 5 may be because the students faced the blood assembled in the receiver with no blood adsorbent surface. Studies showed that the kind of the material of surfaces inoculated in blood was effective in accuracy of blood loss volume estimation, in less absorbable surfaces such as polyvinyl volume of blood loss was overestimated, and in high absorbent surfaces such as forest soil and carpet the volume was underestimated.[25,26] Training is a useful tool for reducing the accuracy error of blood loss volume estimation. The studies have shown that the rate of error of blood loss volume estimation is more in untrained individuals than trained ones.[13] Dildy *et al.* showed that 20 min of speech training increased the accuracy of blood loss volume estimation.[23] Sukprasert *et al.* found that conventional training increased the accuracy of visual estimation of blood loss volume.[27] Akhlaghi *et al.* in a study performed on 44 gynecology residents in Mashhad reported that simulation-based training increases the accuracy of estimation of postpartum hemorrhage volume.[14] In this study also, training led to increased accuracy of estimation of postpartum hemorrhage volume, but no significant differences were found between the three groups of web-based, simulation-based, and conventional training in terms of the mean score of accuracy of estimation of postpartum hemorrhage volume. Anderson *et al.*, on 16 nurses, who have been recently graduated, showed that there were no differences in their grades on physiology, health, and pharmacology between web-based and conventional training groups. Participants in the group of face-to-face training put more hours (time) for learning compared with the web-based training group. The reason of this paradox maybe the few number of subjects (low sample number) for performing the study and loss of suitable cooperation of subjects.[28]

Table 1: Frequency distribution of students according to personal characteristics of estimation of postpartum hemorrhage volume in the three groups of web-based, simulation-based, and conventional training

Variables	Groups *n* (%)			Total	*P* value
	Web-based	Simulation-based	Conventional		
Marital status					
Single	20 (58.82)	22 (62.85)	22 (70.96)	64 (64)	0.611*
Married	14 (41.17)	13 (37.14)	9 (29.03)	36 (36)	
Total	34 (100)	35 (100)	31 (100)	100 (100)	
Course and education semester					
BCs of semester 5	12 (35.29)	9 (25.71)	11 (35.48)	32 (32.00)	0.810**
BCs of semester7	5 (14.70)	10 (28.57)	4 (12.90)	19 (19.00)	
BCs of semester 8	1 (2.94)	1 (2.85)	0 (0)	2 (2.00)	
MSc of semester 1	11 (32.35)	9 (25.71)	10 (32.25)	30 (30.00)	
MSc of semester 3	5 (14.70)	6 (17.14)	6 (19.35)	17 (17.00)	
Total	34 (100)	35 (100)	31 (100)	100 (100)	
Self-assessment of skill of estimation of postpartum hemorrhage volume					
Very high	11 (32.30)	15 (42.85)	10 (32.25)	36 (36)	0.538**
High	11 (32.35)	8 (22.85)	13 (41.93)	32 (32)	
Average	10 (29.41)	7 (20.00)	6 (19.35)	32 (32)	
Low	0	3 (8.57)	1 (3.22)	4 (4)	
Very low	1 (2.94)	1 (2.85)	0	2 (2)	
None	1 (2.94)	1 (2.85)	1 (3.22)	2 (2)	
Total	34 (100)	35 (100)	31 (100)	100 (100)	

*χ^2-test ** Exact χ^2-test

Table 2: The mean and standard deviation scores of estimation of postpartum hemorrhage volume before and after training in the three groups

Group	Before intervention Mean±SD	Confidence interval	After intervention Mean±SD	Confidence interval	Mean difference Mean±SD	Wilcoxon test (*P*)
Web-based	0.64±1.36	±1.34	4.00±2.11	±0.71	3.3±2.4	0.001
Simulation-based	0.25±0.50	±0.17	4.02±2.02	±0.67	3.7±2.0	0.001
Conventional	0.48±0.85	±0.3	4.06±1.84	±0.65	3.5±2.0	0.001
Total	0.46±0.97	±0.18	4.03±1.98	±0.39	3.5±2.1	0.001
Kruskal–Wallis test (*P*)	0.327		0.95		0.652	

Table 3: Frequency distribution of students in terms of accuracy of estimation of postpartum hemorrhage volume before and after training with the separation of the stations

		Before intervention			After intervention			
Station number	Volume (cc)	Under estimation*, %	Correct estimation**, %	Over estimation***, %	Under estimation*, %	Correct estimation** ,%	Over estimation***, %	Wilcoxon test (*P*)
1	10	10	8	82	15	64	21	<0.001
2	10	24	7	69	12	53	35	<0.001
3	20	32	14	54	12	23	65	0.095
4	60	68	4	28	31	56	13	<0.001
5	500	17	19	64	6	71	23	<0.001
6	40	36	5	59	1	62	37	<0.001
7	350	60	2	38	15	48	37	<0.001
8	1000	64	10	26	9	28	63	0.027

*Estimate <20%, less than the actual volume of postpartum hemorrhage **Estimate~20%, more and less than the actual volume of postpartum hemorrhage ***Estimate >20%, more than the actual volume of postpartum hemorrhage

Toledo *et al.*, studied 372 participants of healthcare providers in Chicago Memorial and reported the similar results; the accuracy of estimation of postpartum hemorrhage volume increased significantly after training, but the mean score of estimation of blood loss volume was not significantly different between the two groups of web-based training and face-to-face

Table 4: The mean comparison estimated blood loss accurately of accuracy of estimation of postpartum hemorrhage volume before and after training on marital status, course and education semester, and self-evaluation of the skill of estimation of postpartum hemorrhage volume

Variables	Intercept effect (*P* value)	Group effect (*P* value)	Variable effect (*P* value)	Interaction effect (*P* value)
Marital status	0.100	0.765	0.859	0.154
Course and education semester	0.100	0.202	0.748	0.487
Self-evaluation of the skill of estimation of postpartum hemorrhage volume	0.100	0.711	0.368	0.144

training.[22] These results may indicate that providing only one standard approach of postpartum hemorrhage volume and training it will result in improved accuracy of estimation of bleeding volume. In Gordon *et al*. study (2006) in the USA after training by two methods of simulation and conventional about myocardial infarction and respiratory system diseases, there was no significant differences in written exam grades. In this study, evaluation of students was by use of written exam. Researchers have noted that loss of impact of training may depend on the type of evaluation which was written exam.[29] Moreno *et al*. (2010) in their study on 143 medical students showed that the laboratory performance of students in the web-based simulation was better than the control group. This incoherence (or loss of similarity) with the recent study results maybe for the reason that web-based training is multimedia and there is no interaction between the website and the student, but in Moreno-Gers *et al*., study, they used web-based simulation, they designed an environment like actual laboratory to allow students to decide and exam and make errors. Short exposure to a web-based simulation with low costs improved performance and resulted in more improvement of actual performance of students in web-based simulation during practical sessions.[30] Erfanian *et al*., demonstrated that simulation-based training was more effective than conventional training in increasing the midwifery students' skill for inserting IUD.[17] This result is not consistent with the results of this study which may be due to differences in the types of skills, length of practical training, and short interval between the practical training and test.

The study of Merlin *et al*., on 74 of nurse students showed that there was a significant relevance between years of experience and accuracy of estimated blood loss volume in low volumes of blood loss, because clinical experience increased and accuracy of estimated blood loss in low volume increased.[31] However, the results of Wendy *et al*., which was performed to assess the capacity of 145 physicians, medicine students, residents, and nurses in Texas to estimate blood loss volume, were not in agreement with this study, and they showed that there was no relevance between clinical experience and accuracy of estimation of blood loss volume.[32] Meiser *et al*., showed, in their study on 22 surgery (anesthesiologist, general surgeons, and orthopedics) to evaluate accuracy of blood loss volume, showed that there was no relevance between age, experience, and accuracy of estimation,[33] but capacity of blood loss estimation was influenced by course of studies. The results of some other studies[23,34] also showed that there was no relevance between clinical experience and accuracy of estimated blood loss volume. In our study, there was no significant relevance between age, clinical work experience, level of students' education and accuracy of blood loss estimation after delivery. Although we know that clinical experience results in learning,[33] the reasons of this paradox may be that midwifes, midwifery students, and other healthcare givers estimate the blood loss volume as a daily repeated work and they do that on the basis of their prior learning's and experiences which they had in their mind. Our study is the first study to evaluate the three methods of web-based, simulation-based, and conventional training. Because there was no difference between these methods of training, web-based training, which is an available and a cost-effective method, can be used instead of the two more common methods of simulation-based and conventional training. The strength of this study was the use of synthetic blood with similar viscosity and density to teach the students and compare the three methods of training. The limitation of this study was asynchronous communication of the students with the researcher, its cost, temporary disconnection, and sometimes low speed of Internet when using of website. It is recommended that training of visual estimation of postpartum hemorrhage volume be a part of midwifery student's curriculum and the studies be conducted in terms of training the visual estimation of postpartum hemorrhage volume in the real environment of maternity.

CONCLUSION

The results of our study showed that training increased the accuracy of estimation of postpartum hemorrhage volume and no significant differences were found among the three groups of web-based, simulation-based, and conventional training. We can use web based as a substitute or supplement of training along with two other more common simulation and conventional methods.

By the use of web-based training, the trainers could utilize many education strategies to present the lessons and there is also active learning by students.

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Conflicts of interest

There are no conflicts of interest.

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