Calf muscle pump exercise and preventive measures: as means for prevention of deep vein thrombosis and its manifestations among a postpartum cesarean section

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Abstract:Background:Deep vein thrombosis (DVT) is one of the causes of maternal morbidity and mortality. During pregnancy, and after caesarian section surgery the risk of DVT increases by five-ten times than the other time. It can be prevented through practising of calf muscle pump exercise and following preventive measures as early ambulation.***The purpose of the study:***was to evaluatethe effect of calf muscle pump exercise and preventive measures on the prevention of deep vein thrombosis (DVT)and its manifestationsamong a postpartum cesarean section. **Method**: A quasi-experimental design was used to fulfil the purpose of the study.
Sample: A purposive sample of(200)post-partum women after cesarean section (study and control groups) wererecruited. ***Setting:***The study was carried out atante-natal and post-natal wards of Menoufia University HospitalatShebin El-Kom city at Menoufia Governorate, Egypt.***Instruments:*** Five instrumentswere used by the researchers; (1) An interviewing questionnaire;(2) Author DVT risk assessment scale;(3) Women's knowledge assessment questionnaire;(4) Calf muscle pump exercise and preventive measures questionnaire, and (5)DVTand its manifestations questionnaire.***Results:***The mean age of the control and thestudygroups were (25.16±5.41) and (25.59 ± 5.92) years old respectively.There were highly statistically significant differencesbetween the study and the control groups regarding the level of knowledge, calf muscle pump exercise, preventive measures after the intervention (P<0.05*). Meanwhile, less than one-tenth of the control group had DVT and its manifestations during the follow up at the postpartum period. ***Conclusion:***The study group had higher score regarding the level of knowledge, the performance of calf muscle pump exercise,and followingpreventive measures than the control group. Postpartum women who practiced calf muscle pump exercise and followed the preventive measures had a significant reduction in the occurrence of DVT and its manifestation than those who did not. ***Recommendation:***Strengthen the nurses' role in providing health education about DVT as a preventable disease. Calf muscle pump exercise and preventive measures should be added as an essential part of the routine antenatal care during the third trimester of pregnancy.

Keywords:Deep vein thrombosis (DVT), calf muscle pump exercise, preventive measures, postpartum cesarean section.Venous thromboembolism (VTE).

INTRODUCTION

Venous thromboembolism (VTE) is a serious and preventable disease in patients who were undergone recent surgery [1]. It is considered a silent killer, which kills more people than AIDS, breast cancer, prostate cancer and road accidents combined [2] & [3]. There are 2 forms of VTE: deep vein thrombosis (DVT) and pulmonary embolism (PE). Deep vein thrombosis occurs when a blood clot forms in the deep veins, most commonly in the arms or the legs. Pulmonary embolismoccurs when DVT breaks off and becomes lodged in the lungs [1] & [4]. DVT of the lower limbs and PE continue to be significant causes of post-operative morbidity and mortality [5].

Every postpartum woman after normal vaginal or cesarean section delivery is at risk for a thromboembolic complication[6]. DVT is a serious problem in the antenatal and postpartum periods. Thromboembolic complications are the leading cause of both maternal and fetal morbidity and mortality [5].Due to the physiological changes in the coagulation and circulatory venous systems during pregnancy period. The relative risk of antenatal VTE is approximately 5-folds higher in the pregnant women than in non-pregnant women of the same age, but the absolute risk remains low at around 1 in 1000 pregnancies [7]. These changes are spread across the third trimesters, with more than 50% of the changes occurring in the first half of pregnancy.

The puerperium period is defined by [5] as the time of greatest risk for VTEof approximately 20-fold. Approximately 80% of the changes occur in the first three weeks after delivery (postpartum period) likely because of the trauma to the pelviccavity[5].Furthermore, deep vein thrombosis has been known to be correlated with smoking, major surgical operations, increased age, hospitalization, obesity, neurological deficit, blood transfusion, malignancy, trauma, inherited hypercoagulable state, bedridden and the use of birth control pills[8]&[9].

Globally, the incidence of deep vein thrombosis varies, the incidence of DVT every year estimatesover 4 million patients are affected by DVT. According to the Centers for Disease Control (CDC), the precise number of people affected by DVT/PE is 3, 00,000 to 6, 00,000(1-10 per

1000). The incidence of DVT in India as reported is one percent of the adult population after the age of fifty and is 15% to 20% in hospitalized patients and1 in 100 who developed DVT can develop PE which can be fatal. In Kerala, the prevalence of DVT is 88.5% of critically ill patients belonged to the high-risk group according to the risk assessment model. Every year, an estimated incidence of 10.6 per 100.000 of Americans suffer from DVT and pulmonary embolism[10]. In Egypt, the estimated incidence of VTE is 1 every 5.000 pregnant women every year. The risk of DVT is highest during the postpartum period,[11].

Emergency caesarean birth was associated with an increased the chance of infection, bleeding (increasing the need for blood transfusion) and DVT when compared with both vaginal birth and elective caesarean birth [12] & [13].

In a healthy vein system, each time the calf muscle contracts, or flexes, it forces about 70 % of the blood in the legs back towardsthe heart. When the calf muscle relaxes, the deeper veins in the legs are filled with the blood. The calf pump function decreased in both lower limbs, due to the presence of calf muscle vein reflux (genicular and sural veins*) [14].

The venous return from the lower extremities is vitally dependent on the action of the foot, calf, and thigh muscle pumps, with approximately 90% of the venous return attributes to these muscle structures during the ambulation. Among these, the calf muscle pump plays the most pivotal role, reflected in the fact that it has the largest capacitance and generates the highest pressure, with an Ejection Fraction (EF) of approximately 65% in the healthy women. In comparison, the thigh muscle pump has a significantly lower EF of approximately 15% [15].

Nurses can play a major role in DVT prevention, if well-educated and empowered to increase the level of knowledge and practice among postpartum women through practisingleg exercises continuously. Prevention approach of DVT is an effective approach to reduce the mortality rate due to PE and the morbidity from DVT. Prevention decreases the length of hospital stay, improves the quality of life, decreases rehabilitation time and decreases the economic burden [16]. Several studies assured that the nursing care is provided to the patients should be focused on DVT prophylaxis in addition to implementing the appropriate preventive measures to control DVT, & its manifestation and decrease the morbidity rate effectively [17].

Several previous studies have confirmed the importance of the nursing role in disease prevention like [18] who endorsed that,the nursing intervention for DVT prevention, the patient should eat a light diet and avoid a high-fat and high-sugar foods. The patients should be taught to avoid wearing tight clothes, especially leggings, and to maintainthe warmth at all times, also to avoid the sitting for prolonged periods or lying with legs down, and to lift their legs to a certain height to avoid the blood stasis and to improve the blood flow velocity when supine. While [19] ensuredactiveor passive performance of movements such as flexing, stretching, and footrotation independently or aided

by the nurse during the recovery after surgery. Also, the nurse should ambulate the patient with the risk for DVT early as soon as possible, and give direction to the protocol for the lower limb's functional exercises.

Calf muscle exercise increases the skeletal muscle fiber size, prompts the calf muscle pumping function, and restores the venous hemodynamic.Therefore, keeping the legs healthy and comfortable. [20] & [21] concludedthatthe leg movements are beneficial because they activate the venous pumping mechanism, thus counteracting local edema formation in the leg and the feet, and reduce the discomforts in the seated working postures.

The nurses are the frontlines in terms of delivery of the therapeutic regimens of both prevention and treatment for DVT. They must follow the standards of care and the intervention to prevent this life-threatening complication [3].While [22] ensured that, the means that are used in order to recognize the patients at high risk for DVT are essential in order to be able to apply the proper preventive measures early enough to allay the associated morbidities and mortalities among them.

SIGNIFICANCE OF THE STUDY

Deep vein thrombosis is a serious condition with potentially fatal consequences [23]. Many studies recommended that,the following activities such as early mobilization and calf muscle pumping exercise and increased the patients' knowledge help in the prevention of VTE [5].Knowledge about VTE also allows the patients to self-assess and self-report VTE symptoms not only while in the hospital but also after dischargeand enablingthe patients to obtain timely medical assistance and advice[24] &[5].

An awareness of all aspects of DVT is vital in providingthe optimalnursing care for the patients who were undergoing surgery /delivery / or CS in order to improve the patients' outcomes, reduce the incidence and potentially life-threatening complications of DVT [3] &[25].So, this study concerned on with the evaluation of the effect of calf muscle pump exercise and preventive measures on the prevention of deep vein thrombosis (DVT) and its manifestations among post-partum cesarean section.

Purpose of the study:

The purpose of the study was to evaluatethe effect of calf muscle pump exercise and preventive measures on the prevention of deep vein thrombosis (DVT) and its manifestations among post-partum cesarean section.

Research Hypotheses:

H (1). Postpartum women whopracticecalf muscle pump exercise and follow preventivemeasures will have a higher level of knowledge about DVT &its prevention than those who do not.

H (2). Postpartum women who practice calf muscle pump exercise and follow preventive measures will have a higher score than those who do not.

H (3). Postpartum women who practice calf muscle pump exercise and follow preventive measures will have a significant reduction in the occurrence of DVT and its manifestations than those who do not.

Method:

*Research Design:*A quasi-experimental design was utilized to achieve the purpose of the present study. A quasi-experimental research design attempt to determine causal relationships by applying a treatment or condition to one group (intervention) and comparing the outcome with a control group. Quasi-experimental research is similar to experimental research in that there is manipulation of an independent variable. It necessitates that subjects are randomly assigned to the groups to avoid bias and it controls all extraneous variables and uses a broader array of data collection techniques and statistical analyses **[26].**

*Setting:*This study was conducted at ante-natal and post-natal wards at University Hospital at Shebin El-Kom in Menoufia Governorate, Egypt.The University Hospital has a key role in undergraduate education for healthcare professionals. It provides free and paid services during pregnancy, labour, postpartum and miscarriage. It alsoprovides fertility treatment and gynaecological care for public clients.

Sampling:

A purposive sample of (200)post-partum women after cesarean section. The researchers selected the women who met the following **inclusion criteria**: Including the post-partum women after cesarean (elective and selective C.S.), agree to participate in the study, and ambulatory with or without assistance. Postpartum women with complications during delivery and postpartum period were **excluded** from the study. The cases were then randomly assignedto two equal groups (study and control group). The first group wasthe study group comprised of 100 women and they followed preventive measures about DVTand practiced calf muscle pump exercise. The second was the control group, comprised of 100 women and exposed to routine postpartum hospital care.

The sample size: The total number was 200 postpartum women. The researchers calculated the number of the target population based on the flow rate of the subjects with this specific inclusion and exclusion criteria. It was 480 women delivered by C.S. per year at the target hospital. Online sample size calculators have been searched, reviewed and checked for the calculated results based on known formulas for common research objectives **[27].** The researchers also calculated the sample size by using the creative research systems sample size calculator website. https://www.surveysystem.com/sscalc.htm. So, the sample size was equal to 214women. 14 women dropped out due to losing at the follow-up during the postpartum period. So, the final total sample became 200 postpartum women.

Instruments of data collection:

Five instruments were used to collect the databy the researchers as the following:
Instrument 1: An interviewing questionnaire: This instrumentwas developed and used by the researchers after extensive literature review and it included three parts:
Part 1: Contained questions related to socio-demographic characteristicssuch asage, residency, educational level, and occupation.

Part 2: Contained data related to smoking habit and pastmedical /surgical history such as previous chronic disease, andsurgery.
Part 3: Contained data related to the past and present obstetrichistory such as gravidity, parity, number of children, number of abortions, the duration of current pregnancy and mode of delivery.

*Instrument II: Autar DVT Risk Assessment Scale:*It was modified from **[28]**andadopted from**[29].** It was used in this study to identify the woman's risk factors for the occurrenceof DVT. The scale is a reliable and valid measure that has been tested in trauma and orthopaedic units with 100% sensitivity, 81% specificity, and a correlation coefficient of 0.98.

*Scoring system:*The **Scale** total score is **31** points: it consisted of the following seven distinct risk categories of factors; **age** ([in years] 10-30: 0 point; 31- 40: 1 point; 41-50: 2 points; 51- 60: 3 points; > 61: 4 points) - **body mass index** (16 -19: 0 point; 20-25: 1 point; 26-30: 2 points) . **physical mobility** (ambulant: 0 point; limited with self-assistance: 1 point; very limited with assistance: 2 points; wheelchair-bound: 3 points; complete bed-rest: 4 points) - **particular DVT risks** (contraceptive pills:20-35 years old, 1 point; >35 years old, 2 points; pregnancy or puerperium: 3 points) - **trauma** (head: 1 point; chest: 1 point; spinal: 2 points; pelvic: 3 points; lower limbs: 4 points) - **surgery** (minor: 1 point; major: 2 points; emergency major: 3 points; pelvic: 3 points; thoracic: 3 points; abdominal: 3 points; orthopaedic below the waist: 4 points)- **high-risk disease** (ulcerative colitis: 1 point; sickle cell anaemia: 2 points; polycythaemiaanaemia: 2 points; haemolyticanaemia: 2 points; chronic heart disease: 3 points; myocardial infarction: 4 points; malignancy: 5 points; varicose veins: 6 points; previous DVT or cerebral vascular accident: 7 points).

The scale has four risk levels:

- **No risk**: when score≤6
- **Low Risk (<10%)**: when score 7-10
- **Moderate Risk (11-40%):** when score 11-14
- **High Risk (>41%)**: when score 15≥

Instrument III: Women's knowledge assessment questionnaire.

It was developed by the researchers in the Arabic language based on the recent literature in order to assess the women's level of knowledge in relation to the definition of DVT, risk factors, signs and symptoms, diagnosis, and prevention of it. Reliability test was done whereas Cronbach's Alpha equal 0.892.

Scoring systems:

The total score of knowledge was **26** degrees. Each correct answer had one mark while the incorrect one had zero. These scores were converted into a percent score.The **total score was divided into three categories as follows:**
➢ *Insufficient knowledge:*when the score percentage less than 50%.
➢ *Fair knowledge:* when the score percentage more than or equal 50%and less than70%.
➢ *Good knowledge:*when the score percentage more than or equal 70%.

Instrument 1V: Calf muscle pump exercise and preventive measures questionnaire.

It was developed by the researchers after reviewing the related literature. They concerned with **calf muscle pump exercise and preventive measures** before andafter implementation of the intervention. Reliability test was done whereas Cronbach's Alpha equal 0.992 and 0.952 respectively.

Scoring system:

Questionnaireused the 5-points Likert scale as never=**1,** rare=**2**, sometimes=**3**, often=**4**, and always=**5**. The **total score was** *divided into three categories as follows:*

➢ **Insufficientpreventive measures & calf muscle pump exercise**: when the total score was less than 50%.
➢ **Fair preventive measures & calf muscle pump exercise:** when the total score was more than or equal 50% and less than70%.
➢ **Good preventive measures & calf muscle pump exercise:** when the total score was more than or equal 70%.

InstrumentV: DVT and its manifestations questionnaire:

This instrumentwas developed by the researchers after reviewing the related literature to assess the occurrence of DVT and its manifestations in order to evaluate the effectiveness of calf muscle pump exercise and the preventive measures. It included DVTand its manifestations (swelling, pain or tenderness, red or discoloured skin, increased warmth, cramps, or aching in the area that is swollen or painful). Reliability test was done whereas Cronbach's Alpha equal 0.852.

Validity and reliability:

For validity purposes, the researcher conducted an extensive literature review and developed the questionnaires from the previously used instruments and reviewing the pertinent reviews. Instruments I, III, IV and V was designed by the researchers and revised by five experts in the field of medical-surgical nursing and maternal & newborn health nursing in the Faculty of Nursing of Menoufia and Ain Shams Universities (for content validity), while instrument II was adapted from **Autar(1998)**.Reliability analysis was ascertained with **Cronbach's alpha**to determine the extent to which the items in all instruments are related to each other.

Pilot study:

A pilot study was conducted to assess the applicability of the instruments, the feasibility of the study and to estimate the time needed for data collection. It was conducted on 10 % of the total participants according to the selection criteria.All women participated in the pilot study excluded from the study sample. Based on the results of the pilot studyand expert's opinion, modifications and omissions of some details were done and then set the final fieldwork schedule.

Fieldwork:

This study was carried out through **three consecutive phases:** interviewing & assessment phase, implementation phase and evaluation phase. The data collection period was done for 9 months from the start of May 2018 to the end of January 2019.

1- The interviewing and assessment phase:

During this phase, the researchers explained the purpose of the study, instruments components, preventive measures, calf muscle pump exercise and its technique and the importance for the prevention of DVT. The time needed for completing the questionnaire was ranged from 30 - 45 minutes for each woman.

2- The implementation phase:

▪ In this phase, the selected women who were recruited are randomly assigned to two equal groups (100 women per each). The first group (100) women were the control group which received the routine hospital postpartum care after delivery.

▪ While the **study group** (100) women interviewed individually by the researchers during the third trimester of pregnancy and in the ante-natal room before labour. The session usually started by measuring the weight, height and body mass index, then the researchers start teaching the women the preventive measures and how to practice calf muscle pump exercise technique using some illustrating pictures, and (video films) about this exercise and how to doit. This plan addressed each patient's possibilities and the obstacles to achieve the agreed priorities. The exercise was performed after the recovery from the anaesthesia and in the presence of the researchers to clarify any questions. Each session lasted from 20- 30 minutes.

3- The evaluation phase:

This phase was emphasized on estimating the effect of the intervention on women's level of knowledge, performance of calf muscle pump exercise and following preventive measures, and occurrence of DVT and its manifestations. The post-test was done for both groups during the post-partum period (early and late through **6-8** weeks post-caesarean section). Follow up for the women was done by meeting them in the out-patients clinic for post-partum and post CS follow up, and then by telephone.Both groups were asked about the presence of any signs and symptoms related to DVT. The postpartum followsup wasdone at the end of the first week, up to 4th week, and up to 8th weekspostpartum.

Ethical Considerations:

An official letter was taken from Dean, Faculty of nursing, Menoufia University and submitted to the chairperson of obstetrics and gynaecology department of University Hospital to carry out the study. Official permission was obtained from the directors of the above-mentioned setting to carry out the study. Approaches to ensure the ethics were considered in the study regarding confidentiality and informed consent. Confidentiality was achieved by the use of closed sheets with the names of the participants replaced by numbers. All participants were informed that the information they provided during the study would be kept confidential and used only for statistical purpose.Written informed consent was taken from all women before being enrolled in the study after explaining the purpose of the study. The women were informed that their participation in the study was voluntary and they could withdraw from the study whenever they decide. The findings would be presented as group data with no personal participant's information remained.

Statistical analysis:

The collected data were scored, tabulated and analyzed using (SPSS) version 20.The collected data were presented in tables and graphs using the actual numbers and percentages. Appropriate statistical tests were used to analyze the data as, chi-square test (X^2), independent sample t-test. The level of significance was set at $p < 0.05$.

RESULTS

Table (1) Socio-demographic characteristics of the study participants.

Socio-demographic Characteristics	Control group (n= 100)		Study group (n= 100		Total (n 200)	
	No.	%	No.	%	No.	%
Age: (years)						
Less than20 years.	15	15.0	16	16.0	31	15.5
From 20- 30years.	65	65.0	63	63.0	126	63.0
From31- 40 years.	19	19.0	21	21.0	39	19.5
More than40 years**.**	2	2.0	2	2.0	4	2.0
Range (years old)	19 – 42		19 - 41		19 – 42	
Mean ± SD	25.16 ± 5.41		25.59 ± 5.92		25.37 ± 5.66	
Occupation:						
Working.	36	36.0	36	36.0	72	36.0
Housewife.	64	64.0	64	64.0	128	64.0
Level of Education:						
Illiterate	2	2.0	5	5.0	7	3.5
Read & write	19	19.0	12	12.0	31	15.5
Middle education	35	35.0	41	41.0	76	38.0
High education	44	44.0	42	42.0	86	43.0
Residence:						
Rural	58	58.0	52	52.0	110	55.0
Urban	42	42.0	48	48.0	90	45.0

Table (1), shows that the mean and standard deviation ofage for the control group were (25.16±5.41) and (25.59 ± 5.92) years old for the study group.Regarding the women's occupation, less than two-thirds of the control and the study groups (64.0%) were a control group (42.0%) and less than half of the study group (48.0%) were from the urban area.
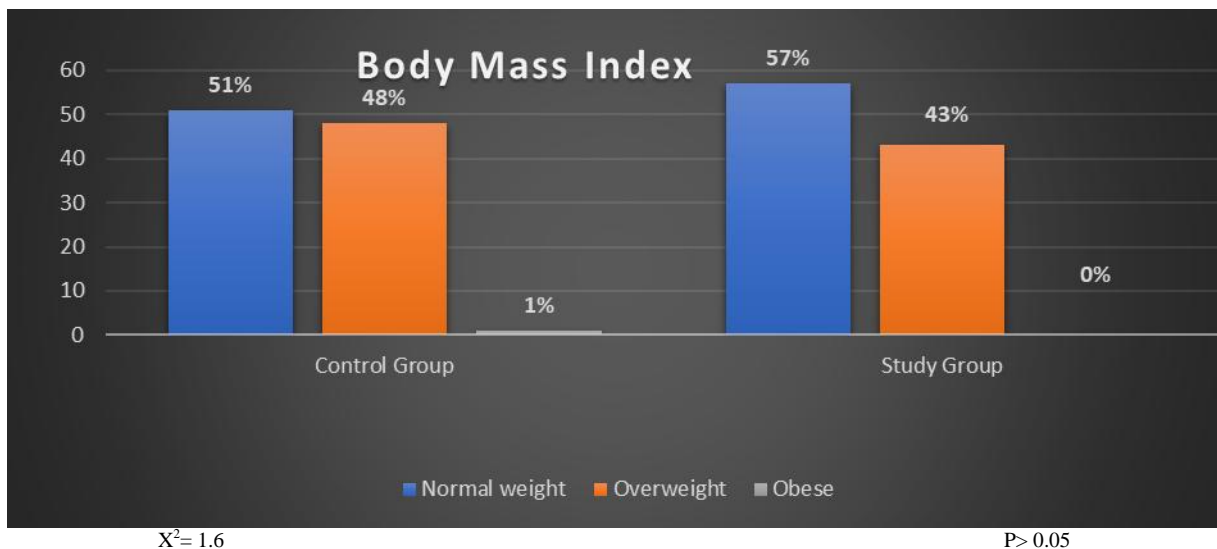

X^2= 1.6   P> 0.05

Fig. (1): Distribution of body mass index among the study participants.

(Fig.1)illustrates that less than half of thecontrol group (48.0%) and more than two-fifths of the study group (43.0%) were overweight.

Table (2): Smoking habit among the study participants.

Variables	Control group (n= 100)		Study group (n= 100)		X^2 P value
	No.	%	No.	%	
Smoker	0	0.0	0	0.0	No test available
Non-smoker	100	100.0	100	100.0	
Passive smoking:					
Exposed	18	18.0	27	27.0	χ2 =2.32
Not exposed	82	82.0	73	73.0	P> 0.05

This table **(Tab.2)** illustrates that all women of the study participants (100.0%) were non-smokers, while the majority of the control group (82.0%) and less than three-quarters of the study group (73.0%) were not exposed to passive smoking.

Table (3): Mean and St. Deviationof past and present obstetric history among thestudy participants.

Variables	Control group (n= 100)		Study group (n= 100)		Test	P value
	Mean	St. Deviation	Mean	St. Deviation		
Gravida:	2.33	1.054	2.15	.998	T=1.23	P> 0.05
Para:	1.09	.888	1.04	.875	T=.40	P> 0.05
No. of abortion:	.18	.386	.10	.389	T=1.45	P> 0.05
No. of children:	1.06	.896	1.00	.876	T=.47	P> 0.05
Duration of the present pregnancy (weeks).	39.21	.555	39.24	.653	T= -.35	P> 0.05

Table (3) shows that the mean number of gravida in the control group were (2.33 ±1.054) and (2.15 ± .998) for the study group. In addition to the mean number of paras in the control group were (1.09 ± .888) and (1.04 ±.875) for the study group. Concerning to the present obstetric history, all women of the study participants were reached to full term pregnancy with the mean duration of the present pregnancy (39.21± .555) in the control group and (39.24 ± .653) weeks in the study group.

Table (4): Distribution of the previouschronic disease& surgery and thetype of present labour among thestudy participants

Variables	Control group (n= 100)		Study group (n= 100)		χ2	P value
	No.	%	No.	%		
Previous chronic disease	0	0.0	0	0.0	No test available	
Previous surgery:	65	65.0	62	62.0	χ2 =1.12	P> 0.05
Type of Present Labor:						
Elective CS.	88	88.0	83	83.0	χ2=1.008[a]	P> 0.05
Selective (Emergency CS)	12	12.0	17	17.0		

Table (4) shows that, There were no previous chronic diseases among the study participants (0%). Near to two-thirds of the study participants had previous surgery in thecontrol and thestudy groups (65% & 62%) respectively.

Regarding the type of present labour, themajority of the study participants in thecontrol and thestudy groups delivered by elective cesarean section (88% & 83%) respectively.

**Fig. (2):Autarrisk assessment scale of the study participants**

Figure (2)reveals that less than one-tenth of thecontrol and thestudy groups were low risk for the occurrence of DVT (2.0%).

Table (5): Immediate postpartum vital signs of the study participants

Variables	Control Group (n= 100)	Study Group (n= 100)	Test	P value
	Mean ± SD	Mean ± SD		
Pulse:	79.27 ± 7.5	78.78 ± 7.88	T=.44	P> 0.05
Systolic Bl. pressure	115.40 ± 7.02	116.6 ± 8.5	T=-1.16	P> 0.05
Diastolic Bl. Pressure	75.25 ± 6.7	76.8 ± 6.4	T= -1.64	P> 0.05
Body Temperature:	37.11 ± 0.37	36.81 ± 1.9	T= 1.54	P> 0.05
Respiration	17.9 ± 1.3	17. 98± 1.27	T=.05	P> 0.05

Table (5) reveals that, themeansand standard deviationsof the pulse, systolic blood pressure, diastolic blood pressure, body temperature and respiration for thecontrol group were (79.27 ± 7.5, 115.40 ± 7.02, 75.25 ± 6.7, 37.11 ± 0.37, 17.9 ± 1.3) respectively, while for thestudy group were (78.78 ± 7.88, 116.6 ± 8.5, 76.8 ± 6.4, 36.81 ± 1.9, 17. 98± 1.27) respectively with no statistically significant differences between the study and control groups.
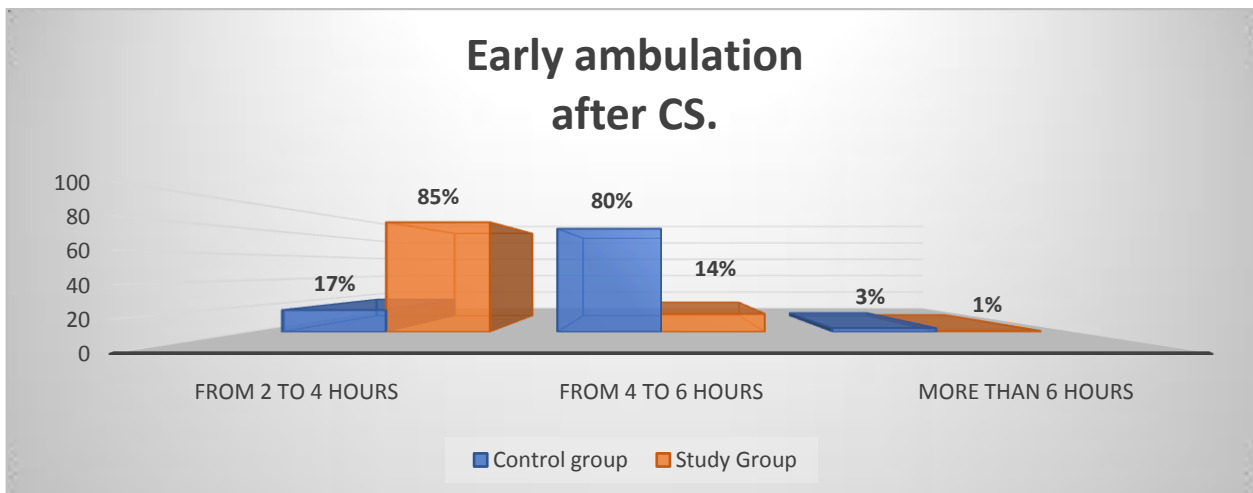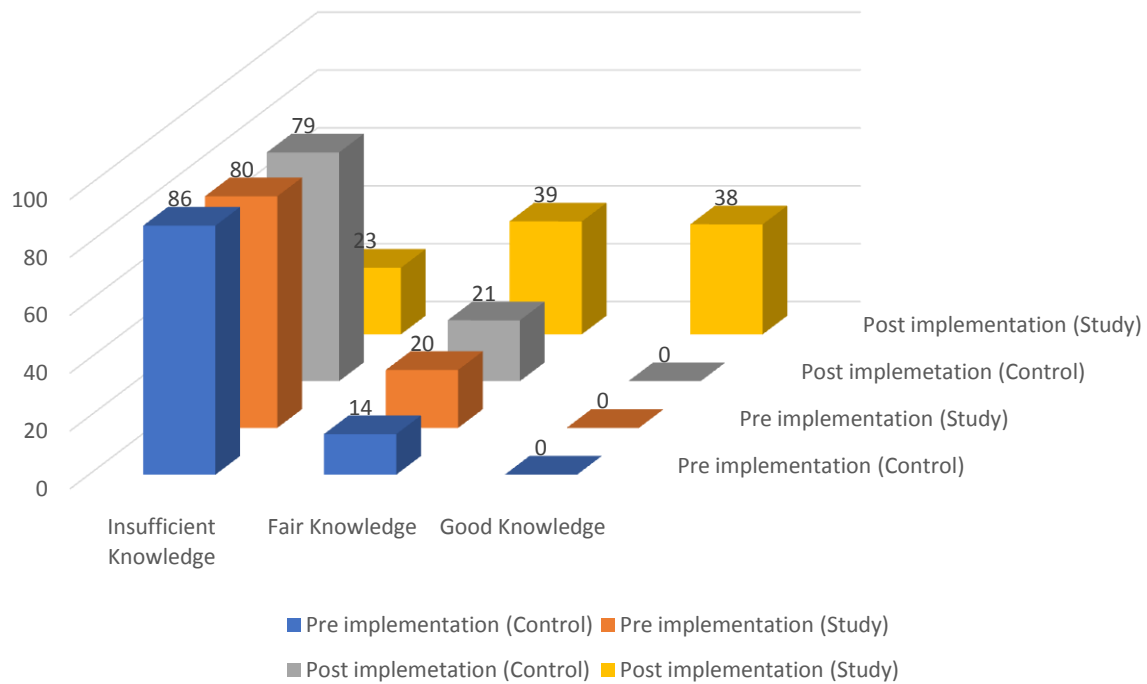

χ^2 =92.6. p<0.000.
* = Significant

Fig. (3): Time of early ambulation after cesarean section of the study participants

Figure (3) Shows that less than one-fifth of thecontrol group (17.0%) and themajority of thestudy group (85.0%) were ambulated early from 2 to 4 hours post cesarean section.

Total knowledge pre: T= 3.20   P> 0.05
Total knowledge post: T= -10.77   p<0.000*.
* = Significant

Fig. (4): Pre and post knowledge level regarding DVT disease among thestudy participants(Control Group =100 & study group =100)

Figure (4) showsthat,pre/post knowledge level regarding DVT disease of the study participants,neither the study group nor the control group had pre good knowledgelevel (0.0%) with no statistically significant difference between them, while after the intervention**,** no one of the control group (0.0%) had good knowledge level, while the percentage had improved in the study group by less than two fifths (38.0%) of them had good knowledge with highly statistically significant difference between them p<0.001*.

Table (6): Calf muscle pump exercise andthepreventive measures for DVT among thestudy participants.

Variables	Calf muscle pump exercise (n= 100)			Preventive measures (n= 100)		
	Control group	**Study group**	**Test**	**Control group**	**Study group**	**P value**
	%	**%**	**P value**	**%**	**%**	
Categories of total scores:						
-Insufficient.	100.0	22.0	χ2 =127.869a	79.0	22.0	χ2 =76.086a
-Fair.	0.0	40.0	p<0.000*	21.0	40.0	p<0.000*.
-Higher.	0.0	38.0		0.0	38.0	

* = Significant

Table (6) shows that neither one of the control group (0.0%) had a high level of practicing calf muscle pump exercise nor following preventive measures for DVT**.** Less than two-fifths of the study group (38.0%) had a high level of practisingcalf muscle pump exercise and followed the preventive measures for DVT with statistically significant differences between the two groups P<0.000*.

Table (7): Postpartum follow up for DVT and its manifestations of the study participants.

Variables	1st week postpartum			Up to 4th week postpartum			Up to 8th week postpartum		
	Control Group.	Study Group.	χ2	Control Group.	Study Group.	χ2	Control Group.	Study Group.	χ2
	%	%	P value	%	%	P value	%	%	P value
DVT	0.0	0.0	No test available	2.0	0.0	χ2 =2.020a P> 0.05	0.0	0.0	No test available
Manifestations of DVT									
1-Swelling	0.0	0.0	No test available	2.0	0.0	χ2 =2.020a	0.0	0.0	No test available
2-Pain or tenderness	0.0	0.0		2.0	0.0		0.0	0.0	
3- Red or discolored skin	0.0	0.0		2.0	0.0	P> 0.05	0.0	0.0	
4- Increased warmth	0.0	0.0		2.0	0.0		0.0	0.0	
5- Cramps, or aching	0.0	0.0		2.0	0.0		0.0	0.0	

* Significant.

Table(7) illustrates that less than one-tenth of the control group had DVT and its manifestations during the 4th week postpartum with the statistically non-significant difference between the study and the control groups.

DISCUSSION

Thromboembolic complications are the leading cause of both maternal and fetal morbidity and mortality.Deep-vein thrombosis is a preventable disease. It can be reduced and prevent its serious and threatening complications when raising education and awareness among public, especially pregnant &labouring women to institute standards preventive measures [30]. So, the purposeof the current study was to evaluate the effect of calf muscle pump exercise and preventive measures on the prevention of deep vein thrombosis (DVT) and its manifestations among apostpartum cesarean section.

Discussion of the present study covered three main areas: **First**,Socio-demographic characteristics, the smoking habit of women under study, reproductive & medical history and Autar DVT risk assessment scale;**Second**,As regards women' ambulation after cesarean section, knowledge level, performance of calf muscle pump exercise and following preventive measures;**Third**, the effect of calf muscle pump exercise and preventive measures on DVT and its manifestations.

Part I:Socio-demographic characteristics, the smoking habit of women under study, reproductive history and Autar DVT risk assessment.

The findings of this study revealed thatthe range of the study participants' age was 19-42 years for the control group and19-41 years for the study group. This finding agreed with [31] who mentioned that the range of age of the pregnant and non-pregnant women at reproductive age was 12–44 years old. In relation to work, less than two-thirds of the study and the control group of women were housewives. This might be related to the fact thatmen in Egypt are working to meet the needs of the home instead of women. This is compatible with [5] whofounded that, during the study of the effect of educationalnursing program on reducing the incidence of venous thromboembolism among postpartum women, they assured that, most of the women were housewives. While This finding of the current study is

not corresponding with[32] who found that the majority of women at reproductive age in his study were working in Korea.

Concerning the level of education and residence, more than two-fifths of the control group and the study group were highly educated and less than half of the study group and more than two-fifths of the control group were from the urban area. This finding is not corresponding with [5] who reported that more than one-fifth of the postpartum women in her study in Egypt was highly educated and less than one-fifth of them was from the urbanarea.

In the present study, all women were a nonsmoker. This might be due to the fact that the subjects were only female. This finding was in accordance with [33] who stated that males were more likely to smoke than females.Considering passive smoking, the majority of the control group and less than three-quarters of the study group were not passive smokers. This finding is not corresponding with[34] who mentioned thatpassive smoking rate of the pregnant women in Yunnan province is high.

When studying the past reproductive history among the women, the results indicated that all women were multigravida and para in both groups and allthe pregnant women were reached to maturity (full term pregnancy)with mean duration of the present pregnancy (39.21± .555) in the control group and (39.24 ± .653) weeks in the study group with no previous chronic disease among the groups. In the same context, [5]assured thatabout two-thirds of the studied women of both groups in their study were multiparous and most of them had no medical condition during pregnancy. While the present reproductive history, themajority of the women in the control and the study groups delivered by elective cesarean section. This explained the fact of the increase in the caesarean section rate had been a global phenomenon [35]and also the maternal autonomy in the decision-making regarding mode of delivery in many cases.

Regarding Autar scale of the study and the control groups before intervention, less than one-tenth of the control and the study groups were low risk for the occurrence of DVT. This might be related to the fact that less than one fifth of the control group and more than one fifth of the study group were 31to 40 years old, less than half of the control group and more than two fifths of the study group were

overweight, and all of them had major surgery (cesarean section) which are Autar DVT risk assessment scale.

Part II: As regards women' ambulation after cesarean section, knowledge level, performance of calf muscle pump exercise and following preventive measures

In relation to the ambulation after cesarean section, the current study results revealed that less than one-fifth of the control group and the majority of the study group were ambulated from 2 to 4 hours post cesarean section and there was a statistically significant difference between the study and the control groups. This difference might be due to the implementation of the intervention and women's wishing to prevent DVT and its manifestations post-cesarean section. This finding was parallel with [36] who stated that early ambulation increased from one third tomore than half in a cesarean section population who attended enhanced recovery after surgery program.

As regards women' knowledge assessment of the study and the control groups before implementation of the intervention, the present study findings revealed that no one of the two groups had good knowledge with no statistically significant difference, while after implementation of the intervention there was improvement in level of knowledge towards DVT and its manifestations with highly statistically significant difference between them.This difference in knowledge found in the present study might be related to the knowledge acquired from the intervention. This is similar to [37] who stated that, a higher level of knowledge scores in the experimental group, with the percentage of the participants in the experimental group answering all questions correctly rising from less than two fifths correct to less than three quarters correct. This finding was parallel with [38] who reported that the patients who received nurse-led patient training had improvement of deep vein thrombosis knowledge and self-care practices. In addition to a study by [5] who initiated that, inadequate level of knowledge of VTE among the participants of the intervention or (study) group during the pretest phase. Theydemonstrated that also there wasan improvement in the level of knowledge significantly about (signs and symptoms, chances of getting DVT, how to prevent DVT, and signs and symptoms of PE) after the implementation of the intervention, from less than one tenth to majority of participants.

Considering the performance of calf muscle pump exercise of the study and the control groups, the present study findings revealed that there were statistically significant differences between the study and the control groups. These differences in performance found among the study and the control groups after implementation of the intervention might be related to the skills acquired from the intervention especially that those women who were keen to acquire the skills that hopefully prevent DVT and its manifestations. This finding was in accordance with [39] who reported that calf strengthening exercise for the postpartum women with varicose veins was adequate for the study group.

In relation to preventive measures of the study and the control groups, there was statistically significant difference among the study and control groups regarding the following preventive measures. This result might be due to the implementation of the intervention and women's desire to attain remission without complications. This finding is in agreement with [40] who mentioned that providing personal clinical effectiveness feedback including data and peer-to-peer coaching improves resident performance, and results in a significant reduction in harm for patients. [41] addedthat direct feedback using dashboards provided venous thromboembolism prophylaxis was associated with significantly improved the compliance.

Part III: Effect of calf muscle pump exercise and the preventive measures on DVT and its manifestations.

Result of the present study showed that less one tenth of control group had DVT and its manifestations during 4th week postpartum while no one of study group had DVT nor its manifestations. This is might be related to the skills and knowledge acquired from the intervention specially that those women who are keen to acquire the skills and knowledge that hopefully might prevent DVT and its manifestations. This finding was supported by [22] who found that implementing the designed nursing guidelines for DVT prevention decrease the incidence of DVT in the group followed by guidelines. In the same context [5] statedthat number of the Egyptian new cases of post-partum venous thromboembolism that occurred among the women who received the educational interventionabout venous thromboembolism prevention were significantly lower than those who received the routine hospital post-partum care. Beside [25] demonstrated that, there was decrease in all items related to the clinical signs and symptoms of DVT in the study group than in the control group during and after one month from discharge and with statistically significant differences observed as ($P \leq 0.001$ & $P < 0.05$) when studying effect of nursing care standards for preventing deep vein thrombosis.

CONCLUSIONS:

According to the results of the present study, it could be concluded that postpartum women who practised calf muscle pump exercise and followed preventive measures had a higher level of knowledge about DVT &its prevention than those who did not and this proved the first research hypothesis.Also, the current study showed thatpostpartum women who practicedcalf muscle pump exercise and followed preventive measures had a higher score than those who did not and this proved the second research hypothesis.

In addition, the current study showed thatpostpartum women who practised calf muscle pump exercise and followed preventive measures had a significant reduction in the occurrence of DVT and its manifestation than those who did not and this proved the third research hypothesis.

RECOMMENDATIONS

In light of the study findings, the following recommendations are proposed:
- Calf muscle pump exercise and preventive measures should be added as an essential part of the routine antenatal care during the third trimester of pregnancy.

- Increased awareness about the risk factors and preventive measures for DVT during pregnancy, labour, and postpartum as well as preoperativehealth education.
- Strict follow up for high-risk women during pregnancy, labour, and post-partum.
- Strengthen the nurses' role in providing health education about DVT as preventable disease and how to prevent it.
- Health education booklet for preventing DVT should be available and distributed for high-risk women.
- *Future research:*The researcher recommends future studies to compare the knowledge, attitude and compliance to calf muscle pump exercise of other hospitals within the community.

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