Editors Committee

Effect of an Educational Program About Cell Salvage Machineon Nurses' Performance During Hepatobiliary Pancreatic Surgeries

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Abstract

Back ground: Intraoperative nurse should be able to perform any role inside the operating room, intraoperative cell salvage machine working inside the operating room so that the intraoperative nurse should be knowledgeable and trained as cell salvage technicians. **Objectives**: This study was carried out to evaluate the effect of an educational program about cell salvage machineon nurses'performance. **Design**: Aquasi-experimental design. **Setting**: In the operatingroom at Alrajhey liver hospital. **Sample**: A convenience sample of all nurses workingin the operating room and ICU (25 nurse). **Tools**: Two tools were utilized to collect data pertinent to the study. (**Tool I**) pre/post Assessment of nurses' knowledge about the liver and cell salvage machine. (Tool **II**) pre/post observational checklist about nurses performance on the cell salvage machine. Data were collected by the researcher during approximately one year started from May 2016 to May 2017.**Results**: Finding of the present study revealed that highly significant statistical differences were existed between knowledge and skills of the studiednurses before and after program. **Conclusion**: Knowledge and skills scores of studied nurses subjected to program were higher at post-test than pre-test.

Keywords: Educational Program, Cell Salvage Machine, Nurses' Performance & Hepatobiliary Pancreatic Surgeries.

Introduction

Pancreatic operation is major procedures which associated risks and complication such as bleeding which may result in blood transfusion. (**King, 2016**) Partial liver resection are treatment of choice for patient with a malignant liver or bile duct tumor, in the most frequent indication for partial liver resections are cortorectal metastasis ,hepatocellular carcinoma and cholangiocarcinoma ,but partial liver resection remains a major surgical procedure carry the risk for excessive blood loss and subsequent need for blood transfusion ,blood transfusion has been associated with systemic side effects such as depression immune system . (**Marieke,2015**) Blood loss and blood transfusion have been inherently with the liver transplantation,it has been attributed to the various factors which are associates with chronic liver malfunction. Many surgical and anesthetic strategies have been developed over the years to diminish bleeding and also to ideal usage of various blood and blood products preoperatively. (**Swamy, 2014**) Excessive blood loss during liver surgery contributes to postoperative morbidity and mortality and the minimizing of blood loss improves outcomes. (**Stephen & Erica, 2012**) Blood transfusion has been broadly used and overused in medical practice early 20th century to treat anemia and blood loss .The efficacy it in enhancing patient results is unsupported by scientific evidence, and its advantages have been mostly taken for granted. Excessive utilization of

transfusion continues despite limited resources of blood on one hand and high cost and serious complications associated with transfusion on the other. (**Yaddanapudi, 2014**) Potential transfusion complications include hemolytic transfusion reaction, transfusion –related acute lung injury (TRALI), allergic and symptoms of circulatory overload, use of cell salvage can be reducing many of these complications of transfusion. (**Haslina & Fakhri, 2012**) A cell salvage, the Autologous Blood Recovery System, suction, washes and filters blood so it can be given back to the patient instead of being thrown away.One benefit of this is that the patient receives his/her own blood instead of donor blood so there is no risk of contracting outsides diseases, because the blood is recirculated,there is no limit to the amount ofblood that is given back to the patient. (**Jiang, Bai, Chen, 2014**) Anesthetic staff nurse who already operating room staff must be trained as cell salvege technicians. (**Lew & Tagore, 2015**) After verify the use of blood salvage with surgeon. The nurse obtain all necessary supplies and equipment, ensure all equipment available and in working order and that there are no compromises in the sterility of package sterile items. Follow the manufacturer's recommendation for system set up and operation, use sterile aseptic technique for sterile items on the sterile field and provide the salvaged RBCs to the anesthesia care provider or (anesthesia nurse) (**Moss, et al., 2013**).Anesthesia care provider or (anesthesia nurse)

should follow standard blood transfusion practice to infuse of the salvaged blood ,baseline observation should be recorded in patient's clinical record prior to commencing the reinfusion of ICS blood ,the patient details (name, date of birth and unique identification number) on the autologous label attached to the reinfusion bag should always be carefully checked against the details on the identification band attached the patient prior to commencing reinfusion of ICS blood, the expiry time on the autologous transfusion label attached to the reinfusion bag should be checked prior to commencing reinfusion of ICS blood, check reinfusion bag for any signs of leakage ,clots or abnormal colour ,set filter, observation should be carried out and recorded in the patient clinical record at least 15 mint from the start of reinfusion and on completion of the reinfusion ,reinfusion of salvaged blood should be documented in the appropriate patient's clinical record ,if a transfusion reaction is suspected ,STOP the transfusion and seek immediate advice from the lead surgeon and anesthetist.(**Ukcellsalvageactiongroup, 2008**) After establish that the operation is over or that no more blood will be collected, the nurse ensure that all blood intended for processing is processed, ensure that all salvaged red cells are re-infused or that reinfusion bag is detached from the processing set ,complete the data collection sheet for ICS, refer to manufacture's guidance for unloading .switch off power supply , dispose of the waste bag/waste bag connects according local policy ,close off all clamps and seal off any open ports , ensure that any open spikes are covered or removed, remove processing set from device and dispose as clinical waste , and wipe down the device and remove blood spillages in line with your local policy and manufacturer's machine specific guidance.(**cell salvage manual**).

Aim of the study

This study aimed to evaluate the effect of an educational program about cell salvage machine on nurses' performance during hepatobiliary pancreatic surgeries.

Significance of the study

Statistics of hepatobiliary pancreatic surgeries at Alrajhey liver hospital in the year from (2/2013) to (8/2015) were 612 surgeries according to Alrajhey liver hospital record (8/2015).

The cell salvage machine is new in our operatingroomof Alrajhey liver hospital therefore the study provide the educational program about cell salvage machine to improvenurses knowledge and skills to prepare the professional nurse who assist the doctor in taking accurate decision or to be decision maker in the emergency situations and this study is the first inthe nursing field at assiut university.

Hypotheses

Studied nurses subjected to the educational program about the cell salvage machine will obtain more scores in their knowledge and skills at post- test than pre-test.

Subjects & Method

Research design

Quasi-experimental research design was utilized to achieve the aim of this study.

Study variables:

-The independent variable was the educational program.

-The dependent variable was operating and critical care nurses' performance.

Setting

The study was conducted in operatingroom at Alrajhey liver hospital.

Sample

A convenient sample of all nurses working in the operatingroom and (ICU) at Alrajhey liver hospital and total number of them were 25 nurse.

Study tools

Two tools were used in this study.

Tool I: Structured pre/post-test questionnaire for assessment knowledge level about anatomy and physiology of the liver, hepatobiliary pancreatic surgeries and the cell salvage machine.This tool was developed by the researcher after reviewing literatures. It was in Arabic language. This toolincluded two parts:

First part: Socio-demographic data of the study sample which include: age, gender, educational level, material status, working place and years of experience.

Second part: Nurses' knowledge questionnaire

This part comprisedof (12) questions related to the following categories;

-Knowledge about definition and functions of the liver which included two questions q (1-2),about definition of hepatobiliary pancreatic surgeries, types and complications of surgeries which include three questions q (3-5) ,and definition of cell salvage machine, indications, contraindications, complications, equipment, how to disinfect andmaintainthe machine which include seven questions from (6-12).

Scoring system for the nurses' knowledge; each item had three answers. The score value 2 to each right answer, 1 to inadequate answer and zero given for unknown answer.

The total score of nurses' knowledge was calculated and classified as follows less than 50%was considered unsatisfactory level and 50% or more was considered satisfactory level.

Tool II: Observational checklist for assessment of nurses' skills.

This tool was developed by the researcher to assess nurses skills related to specific procedures required for working on the cell salvage machine.

The observational checklistincluded 19 steps covered the following procedures; hand washing , prepare the equipment and machine, check the equipment, ensure the suction work properly , connect the equipment properly, connect the wash saline, choose the proper mode for working ,test the machine, identify the time to start machine ,check the surgical site for suction ,observe the machine work properly, identify the most common alarm, label the reinfusion bag (patient name ,time of collection ,the date ,the surgeon , the expire time),identify the time for reinfusion, follow up the reinfusion bag ,identify the time of stopping machine, safety discard the equipment, disinfection of the machine and hand washing.

Scoring system for nurses' skills: the total score for all steps were 38 and every step evaluated as follows; correctly done was scored (2),incorrectly done (1) and not done scored (0).

The total score of the nurses' skills was calculated and classified as follows less than 50% was considered unacceptable level and 50% or more was considered acceptable level.

Learning environment
The program was conducted in the operatingroom at Alrajehy hospital.

Educational methods
- Lecture, discussion by using audiovisual aids.
- Power point presentation.
- Videos about cell salvage machine.
- Demonstration and re- demonstration.

Arranging the subgroups
The total sample was divided into small groups each group contained5 nurses for better performance and understanding.

Educational program
Educational program was designed by the researchers based on previous assessment of the nurses' knowledge and skills, available resources and review relevant literatures. It was written in Arabic language. The program was revised by a group of five experts in the field of critical care nursing and anesthesia medicine. It included two parts.

I-Theoretical design:
It included the following; description of the anatomy and function of the liver, definition of hepatobiliary pancreatic surgeries and its complications, function of the blood, it is components and complications of allogeneic blood transfusion and definition of the cell salvage machine, indication, contraindication, equipment, its side effects or complications, how to connect the cell salvage equipment and how it is work.

II- Operational design
It included preparatory phase, measurement content of validity and reliability of the tools, pilot study, implementation and evaluation phase.

Preparatory phase
- Permission to conduct the study acquired from the hospital responsible authorities after clarification of the aim of the study.
- The tool Iwas developed in Arabic by the researcher based on reviewing the relevant literatures.
- Permission for voluntary participation was obtained from the studied nurses after clarification of the nature and purpose of the study.

Content of validity and reliability
The tools (I&II) of this study were tested for content validity by jury of five specialists in the field of critical care nursing and anesthesia medicineand the reliability was tested for study tools by using Cronbach's alpha (tau-equivalent reliability) coefficient (r= 0.827, 0.859 respectively) which means thatthe internal consistency is "Good", then tools were modified according to the result of pilot study.

Ethical consideration
1. Research proposal approved from ethical committee in the faculty of nursing.
2. Absence of risks was assured for the study subjects during application of the research.
3. The study followedcommonethical principles in clinical research.
4. Confidentially of the data, anonymity and privacy of the subjects were assured.
5. Study subjects have the right to refuse to participate or withdraw from the study without any rational at any time.

A pilot study
was conducted on 10% of the sample in selected setting to assess the applicability and clearly of tools.

Assessment of knowledge was done twice as follows
The first time at beginning of the study, and was considered as pre-test assessment and as base line data for latter comparison with future post-test.
The second administration of questionnaire was carried out after implementation of the educational programs to identity its effect on the nurses' knowledge.

Assessment of the nurses' skills
The researcher observed the nurses' skills using observational checklist tool twice before and immediately after the program implementation.
The researcher completed the checklist while the nurses were working on the cell salvage machine.

Implementation phase

The program was implemented onsmall groups of the studied nurses.All groups were interviewed during break time 30 minutes or one hour in different shifts or before beginning of shift andthey received four sessions in addition to preliminary one.

Preliminary session: in this session the researcher met the participants to clarify the goals, contents and the methods of educational program. (30 minutes)

Session1 included: anatomy, functions of the liver, anatomy and functions of pancreas. (30 minutes)

Session 2 included: signs and symptoms of hepatobiliary pancreatic diseases and types of surgeries and its complications. (60 minutes)

Session 3included: function of the blood, it is components and complications of allogeneic blood transfusion. (30 minutes)

Session 4included:definition of cell salvage machine, indications, and contraindications, advantages, disadvantages, complications, equipment,how to connect the cell salvage equipment and how it is work. (60 minutes)

Group discussion was encouraged with continuous feedback to ensure understanding and achievement of the specific objective of the program.

Active communication was established between the researcher and the nurses to answer any question.Reinforce the gained information and correct actions.

In the last session, the researcher summarized and emphasized the important points.

Each nurse demonstrated and re-demonstrated the steps individually and completely performed the steps ofthe cell salvage machine procedure.

Evaluation phase

Evaluation of the program was carried out immediately after application of the program using the study tools (I&II) in order to test the effectiveness of the program on nurses' knowledge and skills.

Data were collected by the researcher during approximately one year started from May 2016 to May 2017.

Statistical analysis

The data obtained had reviewed, prepared for computer entry, coded, analyzed and tabulated. Descriptive statistics (frequencies and percentages, mean and standard deviation, i.e.) were done using computer program (SPSS) version (22). Independent sample T-test, Chi-square and One-way-ANOVA tests used in the relationship between pre-study and post-study group knowledge and practice. It's considered significant when P. value less than (0.05).

Results

Table (1): Distribution of thestudied group in relation to socio-demographic data:(no= 25).

Socio-demographic data	Study Group	
	n.	%
Age:		
-18 to < 25 yrs.	15	60.0
-25 to 30 yrs.	10	40.0
Mean ± SD	24.1 ± 1.8	
Range	21.0 Y – 29.0 Y	
Gender:		
-Male	1	4.0
-Female	24	96.0
Marital Status:		
-Single	11	44.0
-Married	14	56.0
Experience level:		
-1 Month - < 5 Yrs.	19	76.0
-(5 - 10) Yrs.	6	24.0
Mean ± SD	3.4 ± 2.2	
Range	6.0 M – 10.0 Y	
Job Location:		
-Operating room	16	64.0
-ICU	9	36.0
Education level:		
-Nursing diploma degree	2	8.0
-Health Technician Nursing degree	20	80.0
-Bachelor of Nursing degree	3	12.0
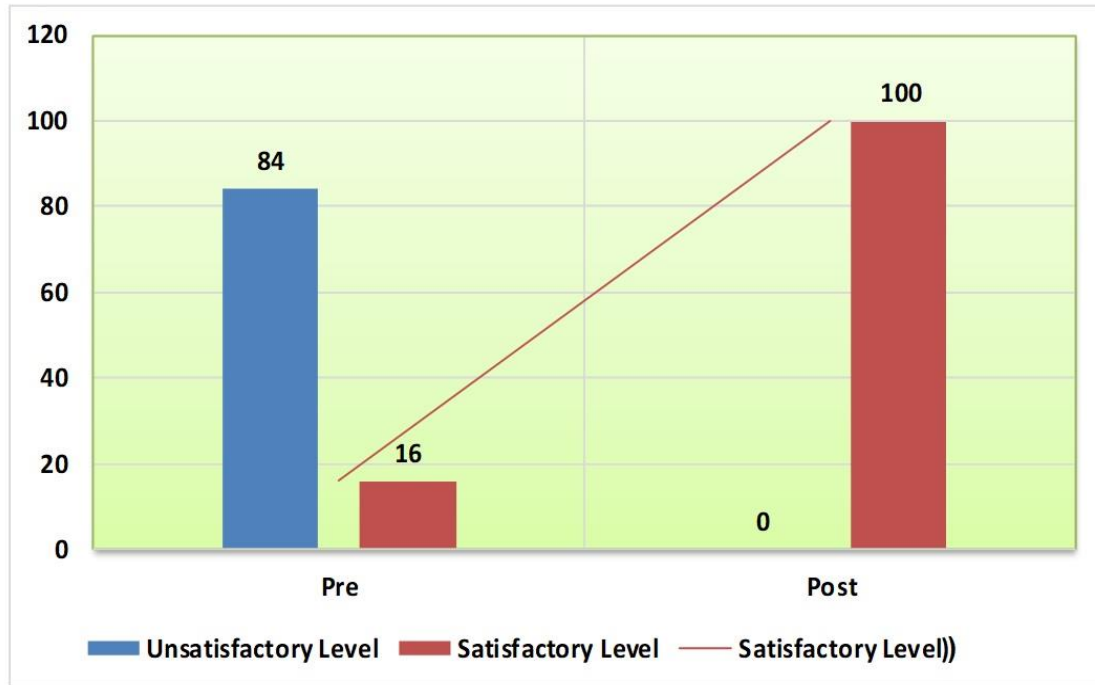
Figure (1): Percentage distribution of nurses' knowledge pre and post program.

Table (2): Percentage & relationship between pre and post knowledge scores of studied nurses: (no= 25).

Items	Pre						Post						F-test	P-value
	Complete Correct		Incomplete Correct		Not Correct		Complete Correct		Incomplete Correct		Not Correct			
	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%		
What is the liver?	0	0.0	24	96.0	1	4.0	13	52.0	12	48.0	0	0.0	3.166	0.002**
What is the liver function?	1	4.0	22	88.0	2	8.0	22	88.0	3	12.0	0	0.0	11.195	0.000***
What is the meaning of liver surgery?	1	4.0	12	48.0	12	48.0	21	84.0	4	16.0	0	0.0	5.040	0.000***
What are the types of liver surgery?	6	24	16	64.0	3	12.0	21	84.0	4	16.0	0	0.0	4.719	0.001**
Complications of liver surgery	0	0.0	22	88.0	3	12.0	23	92.0	2	8.0	0	0.0	13.923	0.000***
What is the meaning of (cell salvage)?	0	0.0	19	76.0	6	24.0	20	80.0	5	20.0	0	0.0	7.596	0.000***
What are the reasons for using it?	2	8.0	15	60.0	8	32.0	17	68.0	8	32.0	0	0.0	5.521	0.000***
What are the barriers to its use?	0	0.0	8	32.0	17	68.0	15	60.0	8	32.0	2	8.0	7.950	0.000***
Complications of its use.	0	0.0	9	36.0	16	64.0	12	48.0	13	52.0	0	0.0	4.635	0.001**
Components of (cell salvage).	0	0.0	15	60.0	10	40.0	9	36.0	16	64.0	0	0.0	3.837	0.001**
Is (cell salvage) life-saving: (Yes/no)?	16	64.0	2	8.0	7	28.0	24	96.0	1	4.0	0	0.0	2.135	0.031*
How to maintain it?	0	0.0	18	72.0	7	28.0	5	20.0	20	80.0	0	0.0	12.537	0.000***

-Statistical significant differences (p < 0.05).   *-Very highly statistical differences P-value (***).*
*-Not significant (p >0.05).*   *-Highly statistical differences P-value (**).*
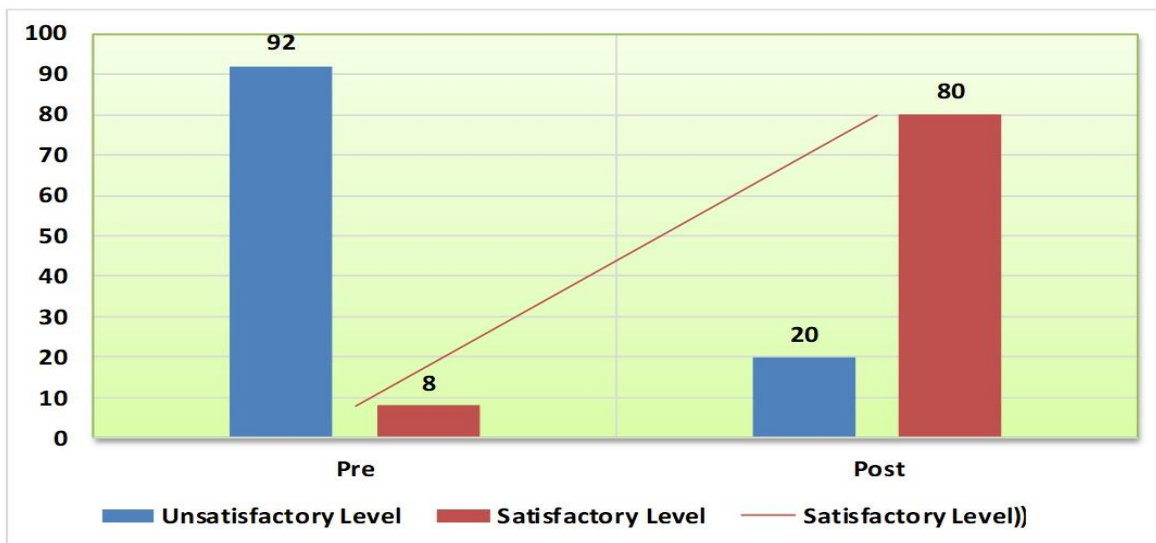
Figure (2): Percentage distribution of nurses'skills pre and post program

Table (3): Percentage & relationship between pre and post skills scores of studied nurses:**(no= 25)**

Items	Pre						Post						F-test	P-value
	Done Correctly		Done Incorrectly		Not Done		Done Correctly		Done Incorrectly		Not Done			
	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%		
Hand washing	20	80.0	0	0.0	5	20.0	25	100.0	0	0.0	0	0.0	4.591	0.037*
Prepare equipment	3	12.0	0	0.0	22	88.0	17	68.0	5	20.0	3	12.0	98.523	0.000***
Check the equipment	4	16.0	0	0.0	21	84.0	11	44.0	11	44.0	3	12.0	45.381	0.001**
Ensure the suction work properly	2	8.0	2	8.0	21	84.0	6	24.0	16	64.0	3	12.0	50.658	0.000***
Connect the equipment properly	0	0.0	1	4.0	24	96.0	4	16.0	17	68.0	4	16.0	54.048	0.000***
Connect the wash saline	1	4.0	1	4.0	23	92.0	4	16.0	12	48.0	9	36.0	72.180	0.000***
Choose the proper mode for work	0	0.0	0	0.0	25	100.0	6	24.0	5	20.0	14	56.0	22.259	0.003**
Test the machine	0	0.0	0	0.0	25	100.0	9	36.0	2	8.0	14	56.0	24.661	0.003**
Identify the time to start machine	1	4.0	0	0.0	24	96.0	20	80.0	1	4.0	4	16.0	37.266	0.001**
Check the surgical site for suction	0	0.0	0	0.0	25	100.0	14	56.0	3	12.0	8	32.0	44.557	0.001**
Observe the machine work properly	0	0.0	0	0.0	25	100.0	2	8.0	0	0.0	23	92.0	2.688	0.108
Identify the most common alarm	0	0.0	0	0.0	25	100.0	2	8.0	1	4.0	22	88.0	3.884	0.055
After the collect blood label (name, time of collection, date, surgeon, expire time)	0	0.0	0	0.0	25	100.0	18	72.0	7	28.0	0	0.0	26.210	0.000***
Identify the time for reinfusion	3	12.0	0	0.0	22	88.0	12	48.0	0	0.0	13	52.0	22.241	0.003**
Follow up the reinfusion bag	3	12.0	1	4.0	21	84.0	14	56.0	2	8.0	9	36.0	20.677	0.003**
Identify the time of stopping machine	5	20.0	0	0.0	20	80.0	17	68.0	1	4.0	7	28.0	30.261	0.001**
Safety discard the equipment	6	24.0	0	0.0	19	76.0	22	88.0	0	0.0	3	12.0	30.508	0.001**
Disinfection the machine	6	24.0	0	0.0	19	76.0	23	92.0	0	0.0	2	8.0	25.769	0.003**
Hand washing	9	36.0	0	0.0	16	64.0	0	0.0	0	0.0	25	100.0	28.160	0.003**

- Statistical significant differences (p < 0.05).   *-Very highly statistical differences P-value (***).*
- Not significant (p>0.05).   *- Highly statistical differences P-value (**).*

Table (4):Relationship between pre nurses knowledge level and socio-demographic characteristics: (no=25).

Socio-demographic data	Nurses knowledge				F-test	P-value
	Satisfactory (n= 4)		Unsatisfactory (n=21)			
	n.	%	n.	%		
Age:						
-18 to < 25 yrs.	1	25.0	14	66.7	0.791	0.639
-25 to 30 yrs.	3	75.0	7	33.3		
Gender:						
-Male	0	0.0	1	4.8	0.213	0.991
-Female	4	100.0	20	95.2		
Marital Status:						
-Single	2	50.0	9	42.9	0.590	0.797
-Married	2	50.0	12	57.1		
Experience level:						
-1 M - < 5 Yrs.	1	25.0	18	85.7	1.154	0.393
-(5 - 10) Yrs.	3	75.0	3	14.3		
Job Location:						
-Operating room	3	75.0	13	61.9	1.826	0.147
-ICU	1	25.0	8	38.1		
Education level:						
-Nursing diploma degree	0	0.0	2	9.5	0.584	0.802
-Health Technician Nursing degree	4	100.0	16	76.2		
-Bachelor of Nursing degree	0	0.0	3	14.3		

-Statistical significant differences (p <0.05).   *-Not significant (p > 0.05).*

Table (5):Relationship between post nurses knowledge level and socio-demographic characteristics :(no=25).

Socio-demographic data	(Post)		F-test	P-value
	Satisfactory (n= 25)			
	n.	%		
Age:				
-18 to < 25 yrs.	19	76.0	0.169	0.992
-25 to 30 yrs.	6	24.0		
Gender:				
-Male	1	4.0	0.400	0.904
-Female	24	96.0		
Marital Status:				
-Single	11	44.0	0.821	0.596
-Married	14	56.0		
Experience level:				
-1 M - < 5 Yrs.	19	76.0	1.257	0.330
-(5 - 10) Yrs.	6	24.0		
Job Location:				
-Operating room	16	64.0	1.638	0.191
-ICU	9	36.0		
Education Level:				
-Nursing diploma degree	2	8.0	0.400	0.904
-Health Technician Nursing degree	20	80.0		
-Bachelor of Nursing degree	3	12.0		

-Statistical significant differences (p < 0.05).   *-Not significant (p>0.05).*

Table (6):Relationship between pre nursesskills level and socio-demographic characteristics :(no=25).

Socio-demographic data	(Pre)				F-test	P-value
	Satisfactory (n= 2)		Unsatisfactory (n=23)			
	n.	%	n.	%		
Age:						
-18 to < 25 yrs.	1	50.0	14	60.9	0.920	0.535
-25 to 30 yrs.	1	50.0	9	39.1		
Gender:						
-Male	0	0.0	1	4.3	0.333	0.950
-Female	2	100.0	22	95.7		
Marital Status:						
-Single	0	0.0	11	47.8	1.212	0.356
-Married	2	100.0	12	52.0		
Experience level:						
-1 M - < 5 Yrs.	2	100.0	17	73.9	0.812	0.614
-(5 - 10) Yrs.	0	0.0	6	26.1		
Job Location:						
-Operating room	1	50.0	15	65.2	1.103	0.416
-ICU	1	50.0	8	34.8		
Education level:						
-Nursing diploma degree	0	0.0	2	8.7	1.184	0.371
Health Technician Nursing degree	1	50.0	19	82.6		
Bachelor of Nursing degree	1	50.0	2	8.7		

-Statistical significant differences (p < 0.05)   *-Not significant (p>0.05)*

Table (7):Relationship between post nursesskills level and socio-demographic characteristics :(no=25).

Socio-demographic data	(Post)				F-test	P-value
	Satisfactory (n= 20)		Unsatisfactory (n= 5)			
	n.	%	n.	%		
Age:						
-18 to < 25 yrs.	12	60.0	3	60.0	0.604	0.808
-25 to 30 yrs.	8	40.0	2	40.0		
Gender:						
-Male	1	5.0	0	0.0	0.372	0.953
-Female	19	95.0	5	100.0		
Marital Status:						
-Single	9	45.0	2	40.0	0.643	0.778
-Married	11	55.0	3	60.0		
Experience level:						
-1 M - < 5 Yrs.	15	75.0	4	80.0	0.647	0.774
-(5 - 10)Yrs.	5	25.0	1	20.0		
Job Location:						
-Operating room	12	60.0	4	80.0	1.697	0.193
-ICU	8	40.0	1	20.0		
Education Level:						
-Nursing diploma degree	2	10.0	0	0.0	1.252	0.358
-Health Technician Nursing degree	15	75.0	5	100.0		
-Bachelor of Nursing degree	3	15.0	0	0.0		

-Statistical significant differences (p <0.05).   *-Not significant (p>0.05).*
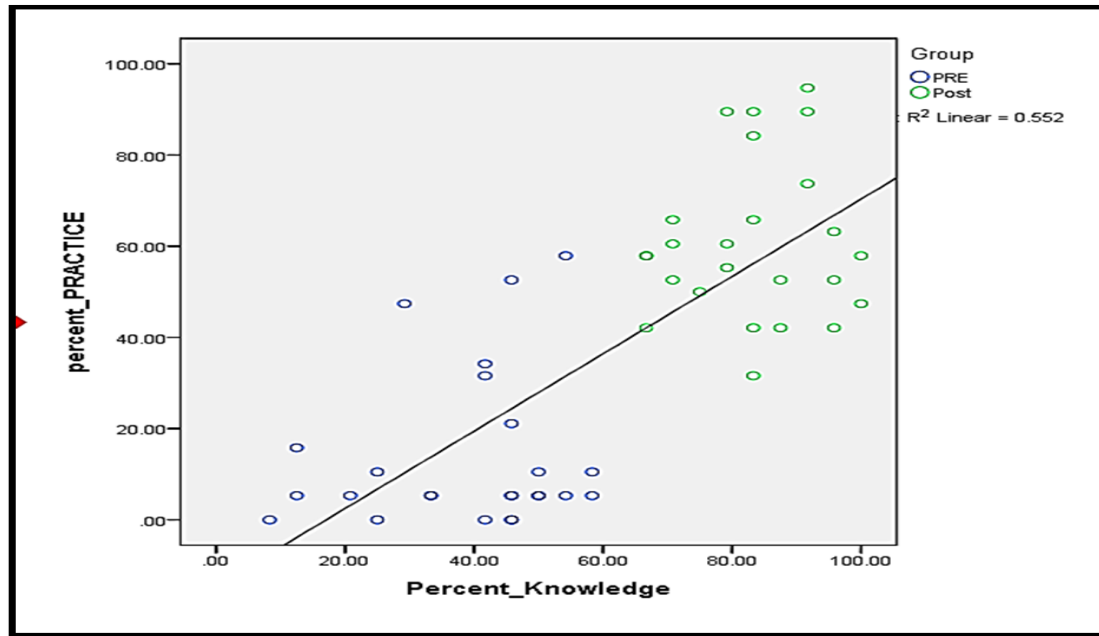
Figure (3):Relation between (pre & post) nurses knowledge and skills.

Table (1): Shows the socio-demographic characteristics of studied nurses, It was found that more than half of the group aged from 18 to < 25 with percentage 60.0%. Vast majority of group were females with percentageof96.0%. The nurses were married with percentage of56.0%. Concerning experience level of nurse 76.0% were from 1 M - < 5 Yrs. More than half of nurses had a job location at operating sections with percentage of 64.0%. Majority of the sample had a health technician nursing degree of education with percentage of 80.0%.

Figure (1): Shows that, A highly statistically significant improvement of nurses' knowledge level was found between pre & post program with percentage of 100.0%.

Table (2): Reflects that, Very highly statistically significant improvement of the most items related to nurses' knowledge scores was found between pre & post program withp-value (0.000).

Figure (2): Shows that, A highly statistically significant improvement of nurses' skills level was found between pre & post program with percentage of80.0%.

Table (3): Demonstrates that, A highly statistically significant improvement of the more than half items related to nurses' skills scores was found between pre & post program with p-value (0.003).

Table (4): Reveals that, No relationship was found between pre nurses knowledge and socio-demographic characteristics.

Table (5): Illustrates that, No relationship was found between post nurses knowledge and socio-demographic characteristics.

Table (6): Illustrates that, No relationship was found between pre nurses skills and socio-demographic characteristics.

Table (7): Illustrates that, No relationship was found between post nurses skill sand socio-demographic characteristics.

Figure (3): Shows that, There was statistically significant correlation between nurses' knowledge and skills.

Discussion

Intraoperative cell salvage(ICS) offers a method of harvesting red cells shed during surgery, processing them and preparing them for safe return to the patient own circulation as autologous red cell transfusion and it is important method of blood conservation. It reduces the need for allogeneic blood transfusion which associated with many complications **Ashworth, (2010).**

It is essential that all staff involved in the operation of intraoperative cell salvage machines are trained to the level at which they are expected to operate. Training should include both theory and practice **Uk cell salvage action group (2008)**.

Nurses play major role in a safe blood transfusion and dealing with ICS machine, nurses in the operating room have two roles 1- sterile nurse who is dealing with blood loss during surgery .They must have knowledge about indication, contraindication of cell salvage and how maintain red blood cell loss, 2-

anesthesia nurse who is dealing with cell salvage machine and blood transfusion. Therefore, it is necessary for nurses to have enough knowledge about cell salvages, amounts, possible side effects and necessary care**.** Regarding evaluation of nurses' performance about cell salvage machine before program implementation, our study found that most of the studied nurses had statistically significant lacking in the basic knowledge and skills about cell salvage machine. This result may be explained by that, the studied nurses didn't receive any training on the machine, the machine is new in this work place, lack of supervision and evaluation system for the nurses during their working. So, this study suggested that a well-developed cell salvage educational program should be delivered to the nurses to provide accurate knowledge and improve skills on cell salvage machine to achieve the goal of this study.

The result of this study clarified that the most nurses age was less than thirty years with experience ranged from 1month to less than 5 years. These finding is supported by **El Gijare, (2012)** who reported that majority of participants in his study age was less than 25 years with experience less than one year and this result is contradicted with **Darawad, et al., (2011)** study who found that the mean age was28.41with an age range from 22 to 47 years old among280 nurses.

This study clarified that the majority of the studied sample were females. This finding is in agreement with **Abudahi, et al., (2012**) who conducted a study over 109 nurses at El-manial university hospital and 220 nurses at Kasr Elaini teaching hospital revealed that majority of nurses were females.

This study clarified that the majority of studied sample had a health technician institute education .This finding is in agreement with **Eldakhakny, et al., (2005**) who carried out a study at the emergency department in the zagazig university hospital, it revealed that, the majority of nurses were diploma nurses and in this regards the nurses syndicate revealed 240.000 nurses in Egypt are registered at the nursing syndicate, 95% of them are diploma and technician institute nurses (about 228.000) and 5%(about 12.000) are bachelor degree nurses **Egyptian Nursing Syndicate, (2012).**

Concerning the impact of the educational program, the results of this study showed a statistically significant improvement in nurses' performance regarding cell salvage machine, this was noticed after program implementation in comparison to pre-test. This improvement may be related to many causes as knowledge refreshment through the program session ,relevance of item of the program content, simple language, increased motivation which was needed for achievement of the desired objectives, availability of sources of information as booklet as well as provision of sufficient materials and supplies needed for achievement the work.

For the educational program, all nurses participated have taken booklet for program objective and content as well as sufficient materials and supplies which not provide at actual work situation. This result is congruent with **(Ahmed & Dutta, 2016**) who reported that knowledge and practice level of nurses significantly improved after the teaching program, also it is congruent with **(Rosenthal, et al., 2012)**who found that educational program was significantly influence the participants performance and in the same line **(Mohamed & Wafa, 2011)** stated that there was a positive statistically correlation between the score of nurses practice and knowledge pre and post implementation program.

This study result clarified that there was a positively and significantly correlation between total nurses' knowledge and skills about cell salvage machine. This study finding is congruent with (**Hunter, 2010)** who identified that, the most importantly, nurses can learn many skills but all of that would be waste if they don't implement the skills in their clinical practice and also **(Zytone, 2009)** exhibited that a highly positive correlation was established between knowledge and practice through staff nurses.

The result of this study clarified that there was statistically insignificant relationship between knowledge and skills regarding cell salvage machine and their socio-demographic data. This result is supported by **(Batool, 2013**) who reported that there was no significant relationship (at p-value -0.515) between nurses' knowledge and their socio-demographic data.

Finally, based on this study the educational program is important to improve nurses' performance.

Conclusion
The results of the present study revealed that there were statistically significant improvement of nurses' knowledge and skills found between pre and post program about cell salvage machine and it was also found that statistically significant correlation between nurses' knowledge and skills.

Recommendations
Based on the study results, the following recommendations are suggested:-
- Strict observation of nurses' performance and assessment about cell salvage machine.
- Availability of written guidelines booklet and poster about cell salvage machine.
- Establishment of continuing educational program including guidelines to improve nurses' knowledge and skills regarding cell salvage machine.

- New research is needed to study the effect of use cell salvage machine for hepatiobiliary pancreatic surgeries on patient outcomes at Alrajhey liver hospital.

References

1. **Abudahi, A., Fekry N., & Elwahab, E., (2012):** Relationship between perceived organization climate and conflict management strategies among nurses researcher. Egyptian nursing journal, 4(7), 29-38.

2. **Ahmed N., Dutta S., (2016):** Effectiveness of planned Teaching Program on nurses' knowledge and practice Regarding Glasgow Coma Scale for Neurological Clients of a Selected Hospital, Kolkata.Available   at http://www.recentscientific.com.

3. **Ashworth A., & Klein A., (2010):** Cell salvage as a part of blood conservation strategy in anaesthesia .Br J anaesh; 105(4):401-416.

4. **Batool A., (2013):** Assessment of nurses knowledge concerning Glasgow coma scale In Neuro Surgical Wards bbasohammedaddoua Journal of Kufa for Nursing Science Vol.(3)No .(2).

5. **Darawad, M., AlHussami, M., & Al-sutari, M., (2011):** Investigating Jordanian Nurses Hand Washing 2011. Available at www.isorjournals.org.

6. **El.Dakhakhny, A., Mohamed, A., & Helaly, N., (2005).** Immediate nursing intervention offered to preschool age children with poisoning .Alexandria journal of pediatrics, 19(1), 223.

7. **Gijare, M., (2012):** Effectiveness of teaching on infection control practices among health care professionals. sinhgad e journal of nursing, 2 (2), 5-9.

8. **Haslina N., & Fakhri M., (2012):** An audit on acute transfusion reaction in North Eastern Malaysia, Scholarly Journal of Medicine; 2(5):60-62.

9. **Hunter J., Krantz S., (2010):** Contractivism in cultural competence education .J NursEducs; 49(4); 207-214.

10. **Jiang G., Bai D., Chen P., (2014):** Modified laparoscopic splenectomy and azygoportal disconnection with cell salvage is feasible and might reduce the need the need for blood transfusion .World J Gastroenterol;20(48):18420-18426.

11. **King R., (2016):** About pancreatic surgery a guide for patient and relatives Pp10-11. Available at www.ouh.nhs.uk/information.

12. **Lew E., & Tagore S., (2015):** Implementation of an obstetric cell salvage service in a tertiary women's hospital. Singapore medical journal; 65(8):445-449.

13. **Manufacture's cell saver manual (2009):** Instructions for use intraoperative cell salvage. The Sorin Group Italia chapter 8 Pp.184-187.

14. **Marieke T., (2015):** Impact of hemostasis and blood loss on outcome after liver surgery chapter 2   Pp.   20.   Available   at http://www.rug.nl/research/portal.

15. **Mohamed, S., & Wafa, A., (2011):** The Effect of an educational program on nurses knowledge and practice related to hepatitis C virus: A pretest and posttest quasi-experimental design Australian journal of basic and applied sciences, 5(1):564-570,2011,ISSN1991-8178.

16. **Moss R., Kneedler J., Pfister J., & Reeves D., (2013):** Transfusion therapy in orthopedic surgical procedures Pp.15.Available at; http:// www.pfiedlerenterprises.com.

17. **Rosenthal, V., Guzman, S., andSafdar N., (2012):** Reduction in nosocomial infection with improve hand hygiene in intensive care units of A tertiary care Hospital inArgentina, American Journal of infection prevention, 33(7), 2012, 392-397.

18. **Stephen J., & Erica J., (2012):** Factors in perioperative care that determine blood loss in liver surgery; HPB (oxford) journal, 14(4):236-241.

19. **Swamy C., (2014):** Blood transfusion practice in the liver transplantation.Indian Journal of Anaesthesia; 58(5):647-651.

20. **Ukcellsalvageactiongroup (2008):** Intraoperative cell salvage Education work book .ed .1.Pp.90.Available   at www.transfusionguidelines.org.uk.

21. **Yaddanapudi S., (2014):** Indication for blood and blood product transfusion. Indiane Journal of Anaesthesia; 58(5):538-542.

22. **Zytone, H., (2009):** Effect of training program on Nurses Knowledge and Performance Related to nursing care of post-operative open heart patient in ICU at Zagazig university Hospital. Unpublished Doctorate Dissertations Faculty of nursing, Zagazig University, Egypt .Pp.124-29.