Effect of Instructional Module about Central Venous Catheter on Nurse's Performance and Patients Outcomes in Selected Hospital

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Abstract: Central venous catheters is an important procedure particularly in the intensive care units. In order to handle Central venous catheters safely, nurses need to acquire theoretical and practical knowledge related to it, which in turn will have positive effect on patients' outcomes. The aim of the study was to assess the effect of instructional module related to Central venous catheters, on nurses' knowledge and performance, and their effect on patients' outcomes (complications/problems). Design: The study used quasi experimental design. Sample: Two hundred and twenty five patients and 60 nurses were included. Tools: Three tools were used to collect the data. 1) A questionnaire which was divided into two parts: a) sociodemographic data. b) Knowledge related to Central Venous Catheters, 2) checklist related to nursing care practices of Central Venus Catheter. 3) An incidence sheet to record the outcomes of Central venous catheters. The results indicated that nurses `knowledge and practices related to Central Venous Catheters had statistically improved at the post test than that of pretest; and less patient complications was recorded among the study group compared to the control group. Conclusion the Instructional Module was effective in improving the nurses` knowledge and practices which lead to reduction in the incidence rate of complications/ problems. Recommendation: In order to correctly and safely handle Central venous catheters, on job training and simple illustrated booklets about the protocol of care of Central Venus Catheter should be available.

Keywords: Central Venous Catheter, intensive care units.

1. INTRODUCTION

A central line is a central venous catheter (CVC), is a long, soft, thin, hollow tube that is placed into a large vein leading to the heart through the neck, upper chest, leg, or arm. It allows measurements of hemodynamic variables that cannot be measured accurately by noninvasive means and provide qualitative information about intravascular volume, intra cardiac pressures, blood flow, oxygen consumption and parameters (1-5). Its uses include, dialysis, nutritional support, and oncology, for administration of chemotherapy, hypertonic antibiotic solutions, multiple administrations of fluids, medications, blood products or parenteral nutrition, and frequent blood sampling and assessment of mean right arterial pressures, as in the cases with active bleeding from recent surgery, acute trauma and /or heart transplantation (6-9).

However, there are many hazards of CVC: infection accounts for 5 to 26 percent, thrombotic 2 to 26 percent, bleeding, pneumothorax and other mechanical complications account for 5 to 19 percent (10-14). Those complications are associated with an increase in morbidity, mortality, and hospital stay, and costly reinsertions (15-20). The insertion can result in complications including pneumothorax, infection, thrombosis, phlebitis, edema, and/or ecchymosis (29) arterial puncture, hemorrhage, and cardiac rhythm dysfunction, infection (30).

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The nurses' role related to the central venous line included preparation for insertion, care during its presence, prevention and management of the complications. Data on bedside practice in prevention of infection of central venous lines (CVL) in general institutions are scarce (20-25). Nurses have to be highly skilled in preparation of sterile and disposable equipment, theater time, monitoring devices, and radiologic confirmation of placement (26-28). The nurse must carry out the aseptic technique such as skin cleansing, use of disinfections, sterile barrier precautions, hands hygiene, change of sets, for monitoring a catheter at entry point, frequency of change of dressing, flushing a catheter, obtaining blood sample, using lock solutions, taking smears of a catheter entry point, adjusting the prescribed infusion liquids, early detection and management of the complications (31-34).

Aim of the study:

The aim of this study was to assess the effect of instructional module (IM) related to CVC on nurses knowledge, practices and patients outcomes as decreasing the incidence of complications/ problems in ICUs patients with CVC.

To achieve this aim the researcher:

l. Developed and implemented Instructional module for staff nurses containing scientific instructions protocol on central venous catheter care.

2. Assessed the knowledge of staff nurses before and after implementing the IM.

3. Evaluated the practices of staff nurses before and after the IM module

4. Assessed the incidence of central venous catheter complications/ problems among the control group before the implementation of the IM and for the study group after IM.

Research hypothesis:

H1: The mean post-test knowledge score of staff nurses on central venous catheter care will be significantly higher than the mean pre-test knowledge score, after attending the instructional module,

H2: The mean post-test practice score of staff nurses on central venous catheter care will be significantly higher than the mean pre-test practice score, after attending the instructional module,

H3: The incidence of CVC complications among the patients will be less after implementing the instructional module.

2. MATERIALS AND METHODS

Design: A quazi experimental research design with pre-posttest was utilized in the study.

Variables under study: The independent variable was the instructional module related to CVC care.

The dependent variables were knowledge and practice scores of staff nurses on CVC care after implementing the instructional module (IM) and patients' outcomes (complications/ problems).

Setting: The study was conducted in the intensive care units (ICUs) at Menoufia University and the Teaching hospitals.

Subjects: The study included: 1. A Purposive sampling technique was used to select 60 staff nurses from medical and surgical intensive care units (ICUs) of both hospitals, who were willing to participate in the study,

2. A convenient sample of 250 patients connected to central venous line(s) for a period of three days or more. All patients with central venous line in the ICUs were consecutively followed during the period of study. The patients were divided into two groups:

A. **Control group** that consisted of 125 patients, who had CVL before the instructional module (intervention),

B. **Study group** that consisted of 125 patients who had CVL after implementing the intervention.

Data collection tools:

The tools developed and utilized for the data collection were:

1. A structured knowledge questionnaire for nurses which was developed by the researcher after extensive review of related literature. It was divided into two parts :

Part I: Demographic data of staff nurses such as age, sex, professional education, years of experience, and attendance of any training courses related to CVC care, complications and prevention, (questions 1-6)

Part II: A structured knowledge questionnaire to assess knowledge of staff nurses about central venous catheter care. It was further divided into: Questions related to nurses` knowledge about anatomy and physiology of circulatory system (questions 7-9), role of the nurse during insertion (questions 10-13), CVC care (questions 14-28), measures of CVC (questions 29-31) complications of CVC (questions 32-35) and infection control measures (questions 36-47) .

The scoring system: If the nurse scored less than 60% correct answers she will have inadequate knowledge, if the nurse scored 60% or more she will have adequate knowledge.

2. A structured observation checklist to assess practices of staff nurses regarding central venous catheter (assist in insertion, care after insertion, obtaining samples (30 steps), medication administration (18 steps), measurement central venous pressures, finally the removal of the line (14 steps) using aseptic technique measures (14**)**.

The scoring system: If the nurse scored less than 60% she will have inadequate practices, if the nurse scored 60% or more she will have adequate practices.

3. A Sheet of incidence of CVC complications/ problems: -

-The control group: This sheet was designed to record the occurrence of complications/ problems for a period of 2 weeks after CVC and, before the IM intervention, through active surveillance;

-for the study group it was used to record the occurrence of complications/ problems for a period of two weeks after the IM intervention.

Implementation:

The first phase: Baseline assessment (it took almost 6 months)

1- Before the intervention, the researcher randomly selected 125 patients (control group) from previous CVP patients stayed for at least 3 days in the ICU to observe them and follow each of them for a period of two weeks to calculate the actual incidences of complications among them. It took almost six months.

2- An Arabic booklet related to knowledge and practices protocol for nurses related to care of patients before and after CVP was developed (The IM intervention) after reviewing the related literature and hospital guidelines.

3- Also, the questionnaire, the checklist related to CVC knowledge and practices and the incidence sheet were developed after reviewing related literature.

4- Assessment of nurse's knowledge related to CVC (pretest)

5- Observation of nurse's practices related to CVC (pretest)

6- Recording the occurrence of complications/ problems among the control group in the developed sheet.

Measurements of Validity, reliability and feasibility:

The validity of the tools was measured by 5 experts from medical –surgical field specialized in intensive care unit, one microbiologist, and nursing education. There suggestions and recommendations were followed.

Reliability of knowledge questionnaire was established by Kudar Richardson (KR-20) formula, and was calculated to be (92%). Reliability of observation checklist was established by interrater reliability and the percentage of agreement among the observers was calculated to be (95%). The tools of the study were found to be valid and reliable.

Pilot study: It was conducted at Menoufia university hospital on 5 nurses to assess the feasibility of the study and it was found to be applicable and feasible all questions were answered and the needed corrections were made.

The second phase (Intervention phase):

Duration: 1 month

Activities:

1- Implementation of the instructional Modules on ICUs nurses to provide them with scientific information to improve their knowledge and practices to decrease the incidence of complications of CVC in ICUs patients.

2- Posttest assessment of level of the knowledge and practices of nurses in ICUs after attending the IM.

The third phase (Post intervention evaluation):

Duration: It took 6 months (from June 2015 to December 2015).

Activities:

1- Reassessment of participant nurses knowledge and practices in ICUs after the IM.

2- Calculation of the reported incidences rate of complications/ problems among the study group using the following formula:

Incidence of CVC –related complications/problems = number of CVC related complications / number of CVC-days (**35**).

3- Comparing the incidence of complications/ problems among the control group and the study group to assess the effect of the IM intervention on patient`s outcomes to assess the success of the IM intervention in achieving the study hypothesis.

Administrative design and Ethical issues: An official permission from Faculty of Nursing, Menoufia University, was taken to both intensive care units. The title and objectives of this study were explained to insure their cooperation. The local authority and managers of ICUs at Menoufia University and the Teaching hospitals were informed about the nature and steps of the study and written consent was taken. The study group was informed about the nature and the purpose of the study and verbal consent was taken before interview. The study group was not exposed to any harm or risk. Patients and nurses data were kept confidential.

Statistical analysis of the recorded data:

The collected data were computerized and statistically analyzed using SPSS program (Statistical Package for Social Science) version **18**. For the statistical calculations Data coding was done, and descriptive data were represented as frequencies and percentages, Chi-square test (**2**), paired sample t test was used. The test results were considered significant when p-value **<0.05**. Statistical Analysis: The data of the present study were planned to be analyzed based on specific objectives and hypothesis. The data obtained from 60 staffs was analyzed using descriptive and inferential statistics as follows: ● Descriptive statistics method such as frequencies and percentage was used to assess the demographic variables and level of knowledge among staff nurses. ● The comparison between the pretest and posttest level of knowledge, practices, complications were evaluated using paired test.

1. The patient`s outcomes (complications/problems).

3. RESULTS

Regarding nurses age, table 1 showed that 88.3 % of the staff nurses were less than 40 years. Also, more than two thirds of the nurses were females (68.3 %) and, 45% had 2-5 years' experience in ICU

Table 2, 3 revealed that nurses' knowledge about central venous line was inadequate in the pre intervention. Regarding the percentage of nurses who had adequate Knowledge of assisting in insertion of central venous line, nurses knowledge improved from 31.7% to reach 91.7%. Likewise, the percentage of nurses who had adequate knowledge regarding care and infection control of central venous line has improved from 15% to reach 80%. Also, adequate' knowledge related to central venous line measurement and sample withdrawal was improved from 23.3% to 86.7% at the post intervention. The differences were statistically significant (p value between, 00, and 000).

Table (4, 5) clarified that nurses practice`s related to central venous line was inadequate in the pre- intervention. The adequate performance improved from (18.3% to be 70%)related to care of CVL and from (45% to 93.3%) in practices related to giving medication. Also, there was highly statistical significant improvement in nurses' practices related to measurements and taking samples. In addition, the adequate knowledge improved for assisting in removal of the line (21.7% to 98.3%), changing solution, and complications management from (16.8%, 16.7% to 96.7%, and 81.3%)respectively. The difference was statistical significant (p < 00) in nurses' practices after the intervention related to the central venous line than before the intervention.

Table 6 and figure1illustrated that there was statistical significant decrease in the incidence of complications or problems related to central venous line (p <000) after the intervention.

Table 7 clarified that the frequency and percentages of incidence of complications had dropped post intervention where none of the patients got thrombosis, air embolism or ischemia compared to pre intervention where 3 patients (1.2%) had thrombosis, 2 patients (.8%) had embolism. And 3 patients (1.2%) had ischemia.

4. DISCUSSION

Central venous catheters (CVCs) are used with increasing frequency in the intensive care unit and in general medical wards. It is associated with frequent complication and increased morbidity, mortality, and increased duration of hospital stay. Those complications can be prevented through improving the nursing performance after providing them with adequate knowledge and practices.

Knowledge: The results of this study illustrated that nurses had inadequate knowledge in the pretest (before implementation of the instructional module). Meanwhile, the findings of the current study revealed that the mean knowledge score regarding venous access device care was increased in the post- intervention than that of the pre-intervention. The improvement in knowledge was statistically significant. These findings indicated nurses were in need for updating and refreshing their knowledge and that the instructional module was effective in enhancing the knowledge of the staff nurses regarding CVC monitoring. This finding is in the same line with Kumari (2015)[36] and Dunfee[37] who found more than half of their studied nurses had inadequate knowledge at the pretest regarding CVC monitoring, and 80% of them in the posttest got adequate knowledge. Likewise, Koutzavekiaris et al (2011)[38] and, Deshmukh & Shinde (2014)[39] found that the structured education was effective on improving knowledge of staff nurses regarding venous access device care.

Practices: As regard staff nurses practices, the results of the current study revealed that there was increase in staff nurses adequate practice scores in the posttest than that of the pretest and the difference was statistically significant. This findings indicates that the instructional module was an effective intervention that affected nurses knowledge which in turn improved their practices. In the same line Koutzavekiaris et al (2011)[38] and, Deshmukh & Shinde (2014)[39] found that their structured education was effective on improving practices of the experimental group of the study staff nurses regarding venous access device care in at the post-test after implementing the structured education. These findings suggests a strong statistical relation between improvements of nurses' knowledge and practices and implementation of the IM interventions and reflect the nurses need for continuous training to keep them updated in their knowledge and practices.

Incidence of complications/problems:

Likewise, the findings of the current study illustrated that there was statistical significant decrease in the incidence of complications or problems related to care of central venous line (p < 000) among patients undergoing CVC after implementation of the IM. This finding is congruent with the findings of David (2006)[42] who reported that educational intervention among nurses and physicians in a nonteaching community hospital resulted in a significant, sustained reduction in the incidence of catheter-associated bloodstream infection. Also, Labeau et al (2008), [40] illustrated that interventions primarily directed at the ICU nursing staff can lead to a dramatic decrease in the incidence of primary bloodstream infections. They studied Seventy-four primary bloodstream infections occurred in 6874 catheter days (10.8 per 1000 catheter days) in the 18 months before the intervention. After the implementation of the education module, the number of primary bloodstream infections fell to 26 in 7044 catheter days (3.7 per 1000 catheter days), a decrease of 66% (p < .0001). The estimated cost savings secondary to the decreased infection rate for the 18 months after the intervention was between $185,000 and $2.808 million. These findings means that the implementation of the IM programs increased nurses compliance with care recommendations and lead to a substantial decrease in morbidity, and mortality attributable to central venous catheterization.

5. CONCLUSION

The result from this study revealed that the staff nurses knowledge on care of patient with central venous catheter was inadequate in the pre intervention which improved significantly after implementing the instructional module (post intervention). This finding means that the instructional Module was an effective method in increasing and updating the knowledge regarding nursing care of patient with central venous catheter among staff nurses. Also, the findings of the

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study revealed that there were significant increase in the post test practice scores after administration of the Instructional Module and decrease in incidence of complications/ problems. This means that the instructional module developed related to central venous catheter arterial line care was found to be effective in improving the knowledge of ICU staff nurses to a great extent. This increase in knowledge would result in better practice among staff nurses which would result in decrease of complications/problems morbidity and mortality of patients.

6. RECOMMENDATIONS

The instructional module can be used for a larger population of staff nurses to improve their knowledge and practice and thereby reduce complications related to central venous catheterization.

It is suggested that the nurse educators should develop instructional modules as a learning source material available to staff nurses in clinical settings for learning at their own time and pace, build flexibility and create awareness among staff nurses about significance of self-directed learning.

Administration of hospitals in government, private and corporate should encourage formulation of uniform protocols regarding similar nursing care facets to be followed in all procedures.

Along with that Intensive care unit nurses should be well equipped with the advancing knowledge and practices in patient care.

Simple illustrated booklets about central venous care and complications management should be available through instructive teaching, practical workshops, simulations, video skill demonstrations, and responsibility with the use of a checklist system.

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APPENDIX - A

Table (1) the frequency distribution of the nurses 'age, sex, education and the experience in the intensive care units (Total number 60 nurses).

Characteristic of the nurses		Frequency	Percentage (%)
The nurse age	less 40	53	88.3
	between 40-60	7	11.7
nurses sex	Male	19	31.7
	Female	41	68.3
Education	Bachelor	32	53.3
	technical institute	28	46.7
Years of experience in the intensive care unit	less 2	9	15.0
	from 2 -5	27	45.0
	from 5-8	15	25.0
	from 8-11	9	15.0

Table (2) nurses' knowledge pre and post interventions related to the central venous line.

Level of knowledge	Pre intervention				Std. Deviation	Post intervention				Std. Deviation
	Adequate	%	Inadequate	%		Adequate	%	Inadequate	%	
Knowledge of assist in insertion of central venous line	19	31.7	41	68.3	.469	55	91.7	5	8.3	.279
knowledge of care and infection control of central venous line	9	15	51	85	.360	48	80	12	20	.403
knowledge related to central venous line measurement and sample withdrawal	14	23.3	46	76.7	.427	52	86.7	8	13.3	.343

Table (3) Comparison between nurses' knowledge pre and post interventions related to the central venous line.

| Nurses knowledge	Paired Differences						T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pre-post knowledge related to central venous line insertion	-.600-	.558	.072	-.744-	-.456-		-8.322-	59	.000
Pre-post knowledge to central venous line care and infection control	-.650-	.481	.062	-.774-	-.526-		-10.468-	59	.000
Pre-post knowledge related to central venous line measurement and sample withdrawal	-.633-	.551	.071	-.776-	-.491-		-8.898-	59	.000
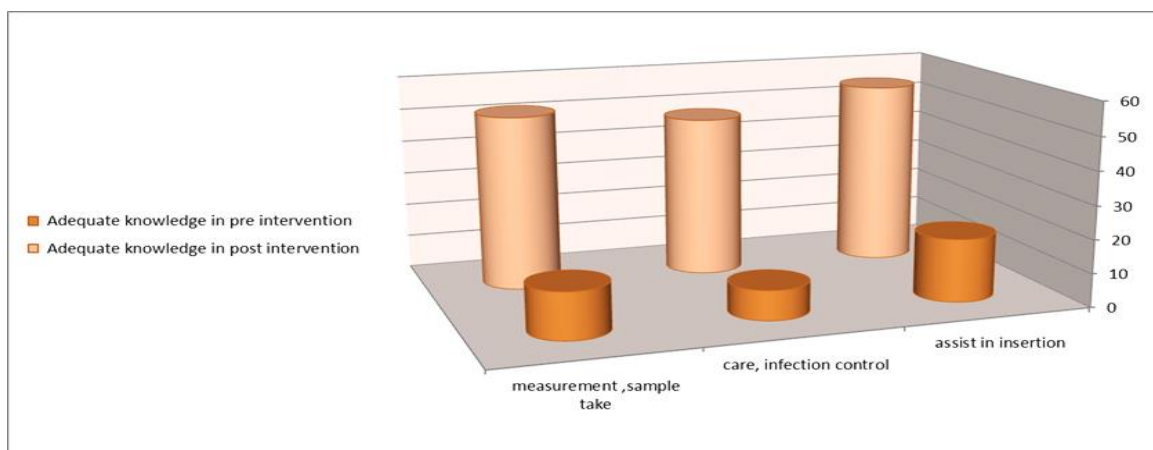
Figure (1) nurses' knowledge pre and post interventions related to the central venous line.

Table (4) nurses' practice pre and post interventions related to the central venous line

Level of practices	Pre intervention				Mean	Std. Deviation	Post intervention				Mean	Std. Deviation
	Adequate	%	Inadequate	%			Adequate	%	Inadequate	%		
practices related to care of central venous line	11	18.3	49	81	1.18	.390	42	70	18	30	1.70	.462
practices related to given medications	27	45	33	55	1.45	.502	56	93.3	4	6.7	1.93	.252
practices related to measurement and taking sample	3	5	57	95	1.33	.475	60	100	0	0	2.00	.000
practices related to assist removal	13	21.7	47	78.3	1.78	.415	59	98.3	1	1.7	1.98	.129
practices related to Change solution	18	16.8	42	70	1.30	.462	58	96.7	2	3.3	1.97	.181
practices related to Complications management	10	16.7	50	83.3	1.17	.376	49	81.7	11	18.3	1.82	.390

Table (5) Comparison between nurses practices pre- post intervention related to the central venous line.

| Practices	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-post practices related to central venous line during taking sample	-.583-	.497	.064	-.712-	-.455-	-9.088-	59	.000
Pre-post practices related to central venous complication management	-.650-	.515	.066	-.783-	-.517-	-9.776-	59	.000
Pre-post practices related to care	-.517-	.567	.073	-.663-	-.370-	-7.055-	59	.000
Pre-post practices related to change solution	-.667-	.510	.066	-.798-	-.535-	-10.130-	59	.000
Pre-post practices related to giving medications	-.483-	.567	.073	-.630-	-.337-	-6.600-	59	.000
Pre-post practices related to measurement	.050	.220	.028	-.007-	.107	1.762	59	.083
Pre-post practices related to assist in removal of the pack	-.200-	.443	.057	-.315-	-.085-	-3.494-	59	.001
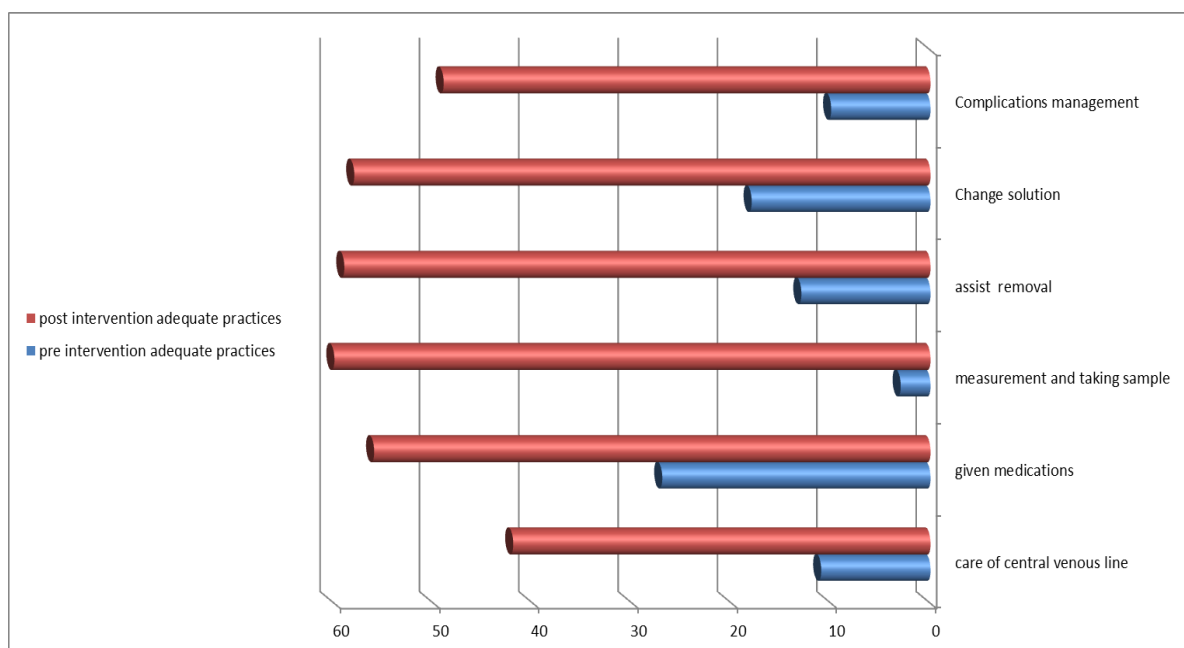
Figure (2) Comparison between nurses practices pre- post intervention related to the central venous line.

Table 6. Pre- post comparison between occurrence of problems and complications among the control and study groups

Complications	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre- post incidence of complications/ problems related to central venous line	.584	1.287	.081	.424	.744	7.172	249	.000

Table (7) incidence complications related to central venous line(pre intervention- post intervention)

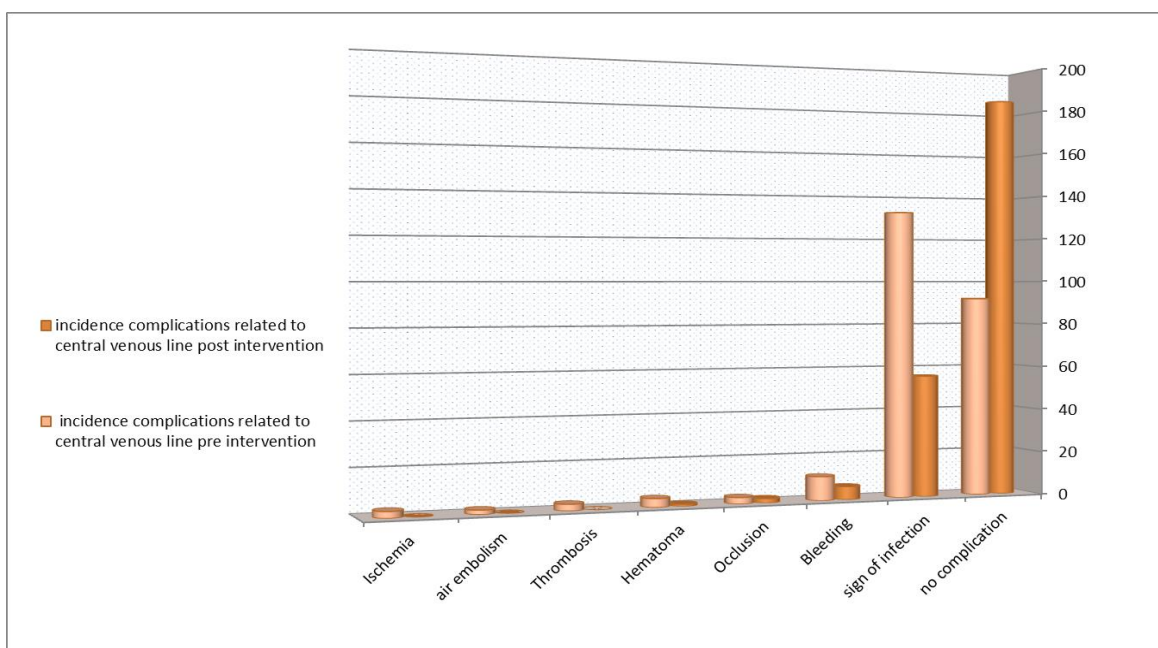| Items of complications	incidence complications related to central venous line pre intervention		incidence of complications related to central venous line post intervention	
	Frequency	Percent	Frequency	Percent
no complication	92	36.8	185	74.0
sign of infection	132	52.8	56	22.4
Bleeding	11	4.4	6	2.4
Occlusion	3	1.2	2	.8
Hematoma	4	1.6	1	.4
Thrombosis	3	1.2	0	0
air embolism	2	.8	0	0
Ischemia	3	1.2	0	0
Total	250	100.0	250	100.0

Figure (3) the complications related to central venous line(pre intervention- post intervention)