IOSR Journal of Nursing and Health Science (IOSR-JNHS)
e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 4, Issue 4 Ver. IV (Jul. - Aug. 2015), PP 42-55
www.iosrjournals.org

Comparison the effect of conservative therapy and blow bottle among open heart surgery patients for the prevention of postoperative pulmonary complications

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Abstract: *A decrease in pulmonary function is well known after open heart surgery. Roentgenological signs of atelectasis are common, reduced lung volumes and oxygenation in the post-operative period. Post-operative treatment includes early mobilization, change of position, breathing exercises and coughing techniques. Various mechanical devices have been used in order to improve post-operative pulmonary function, for example incentive spirometry, continuous positive airway pressure and intermittent positive pressure breathing and blow bottle device. The blow bottle is another technique to produce expiratory resistance and the initial rationale for the technique was to expand the lungs.*

Design *A quasi –experimental design.*

Setting, *The study was conducted in postoperative intensive care unit of Assiut university hospitals.*

Subject,*a convenience sample of 50 adult open heart patients of both sexes.*

Group1 (*conservative therapy****), and group2 (****blow bottle****)]*** *25 patients for each.*

Tools*, Two tools were developed in this study,* ***tool one*** *(Patient's socio demographic characteristics and health status tool among open heart patients),****tool two*** *(Observation checklist for post-operative pulmonary complications among open heart surgical patients).*

Result *of this study revealed that a statistical significant difference was found between the two groups regarding to atalectasis p (0.044). As regard pulmonary secretion it was noticed that percent 72% of patients in group 1(incentive spirometer), while 60% of patients having pulmonary secretion in group 2(blow bottle).*

Conclusion *of this study illustrated that a positive effects of PEP (blow bottle)than conservative therapy on occurrence of pulmonary complications among open heart patients postoperatively. Patients who performed deep breathing exercises with a blow bottle device postoperatively showed a significantly smaller amount of secretions and atelectasis, improved oxygenation and had less reduction in FVC and FEV1 on the fourth postoperative day compared to conservative therapy .*

Recommendations*, Explain to the nurse the deference between deep breathing exercise alone and deep breathing exercise with anther maneuver such as blow bottle device, and the effectiveness on respiratory system for preventing respiratory complications.*

Key words: *open heart surgery. Blow bottle, conservative therapy, and postoperative pulmonary complications.*

I. Introduction

Patients are at risk of various complications after abdominal and cardiothoracic surgery; common ones include pulmonary dysfunction, deep vein thrombosis and wound infections. Pulmonary complications can have serious consequences including prolonged hospital stay, higher healthcare costs and negative health outcomes **(Westwood et al, 2010)**[(1)]. Over a quarter of complications are related to the pulmonary system in surgical patients. The risks and severity of such complications after abdominal and cardiothoracic can be reduced by the judicious use of therapeutic manoeuvres that increase lung volume. **(Kulaylat and Dayton, 2012)**[(2)].

The open-heart surgical patient presents the great challenge to nurses in intensive care units **(Hery& Thompson,2005)**[(3)]. Open-heart surgical patients are exposed to the occurrence of postoperative pulmonary complications due to the effect of cardiopulmonary bypass machine, anesthesia, and compression of the lung tissue from injury to the phrenic never that causes diaphragmatic dysfunction and postoperative incisional pain **(Sculler& Marrow, 2007)**[(4)]**.**

The major causes of PPCs may be related to shallow breathing and monotonous tidal volume in post-operative patients (**Bartlett etal, 2010**)[(5)] ,other causes such as anesthesia, opioid analgesia, and postoperative pain also seem to contribute to this ventilation pattern without spontaneous deep breaths that occurs every 5 or

10 minutes (Duggan & Kavanagh, 2010)[6].Moreover, presence of risk factors as underling cardiac pathology, smoking, chronic obstructive pulmonary disease, age, and obesity increase the incidence of pulmonary complications (**Curley et al, 2006**) [7].Comprehensive pulmonary care can prevent a prolonged stay in intensive care unit with its many attendant complications.

To prevent or treat these complications, pre-and postoperative chest physical therapy is often prescribed. In some countries, deep breathing exercises with Positive Expiratory Pressure (PEP) are regularly suggested to patients who are unable to take deep breaths after cardiac surgery. The technique provides resistance on expiration and aims to improve lung volumes and to facilitate secretion mobilization, although the physiological explanation for these outcomes is unclear. Several assistive PEP devices have been developed, including the blow bottle system, PEP masks, and valves. The technique can also be carried out through pursed-lip breathing, which does not require equipment (**Johansson etal ,2013)[8].**

Chest physiotherapy is routinely used in order to prevent or reduce pulmonary complications after surgery, was initially aimed to improve ventilation and oxygenation by removing secretions from the airways. In an effort to increase lung volume following surgery, various deep breathing maneuvers have been implemented as a main component in the care of the postoperative patient. Today, Post-operative treatment includes early mobilization, change position breathing exercises and coughing techniques **(Ingwersen et al, 2005)** [9]. various chest physiotherapy techniques are used after cardiac surgery for example incentive spirometer, continuous positive airway pressure and intermittent positive pressure breathing, positive expiratory pressure (PEP) as blow bottle is a another technique to produce expiratory resistance and initial rationale for the technique was to expand the lungs. The use of PEP in postoperative care is mostly intended to increase pulmonary volume, facilitate the release of pulmonary secretions and increase Tran's pulmonary pressures resulting in an increased functional residual capacity (FRC). In healthy subjects, PEP increases tidal volume by activity of both expiratory and inspiratory muscles, **(Westerdah et al, 2001-Savci et al, 2006)** [10, 11].

Aim of the Stud

This study aimed to: - Evaluate the efficacy of conservative therapy, and blow bottle on the prevention of postoperative pulmonary complications after open heart surgery patients.

Research hypotheses

To fulfill the aim of the study following research hypothesis were formulated:

- Post-operative open heart surgery patients using blow bottle expressing mild pulmonary secretion and improve expansion of the lung than other maneuvers.

II. Subject and Method

Research Design:-

A quasi –experimental design was utilized to fulfill the aim of this study .This design was used to explain relationships, clarify certain events happened or both.

Material:-

Variables:-

- Independent variables in this study are conservative and blow bottle.
- Dependant variables are patient's respiratory complications.

Sitting

- The study was conducted in postoperative intensive care unit at Assiut university hospitals.

Subject:-

A convenience sample of 50 adult open heart patients of both sexes constitutes the study sample. The subjects were assigned into two groups. Group1 (conservative therapy), andgroup2 (blow bottle)] ,25 patients for each.

Inclusions criteria:-

- adult aged from 20-50 years,
- Extubated within 4-6 hours after open heart surgery,
- End expiratory pressure <5%,
- No fever in first four days postopratively,
- No respiratory disease,
- Fraction inspired oxygen > 40% on mechanical ventilator and No pain after operation.

Study Tools

Two tools were developed and used by the researcher in this study after reviewing the related literatures (**westerdhi, 2004**).

Tool I: - Patient's socio demographic characteristics and health status assessment sheet among open heart surgery patients, this tool was includes

Part I:-

Patient's socio demographic data (patient code, age, sex, marital status, occupation …….)

Part II:-

clinical data which include, past medical history for(Cyanosis, Streptococcal infections, Rheumatic fever, Diseases as heart failure, Allergies), medical diagnose, date of admission, date of intubation on mechanical ventilion, patient weight and height, Times from extubation, Duration of operation, Type of operation, Data of operation, ,Time of operation, time of chest tube removal.

Part III:-

- Preoperative medications (Intropics, Coronary vasodilator, Antihypertension, diuretics, hypoglycemic, Others).
- Health habits (Use of tea and coffee, Use of alcohol, Smoking, Exercise) .
- Hereditary diseases (Diabetes, Renal disease, Congenital heart disease and hypertension) and Previous cardiac surgery.

Part VI:-

- vital signs as heart rate (HR),temperature and respiratory rate.

Part V: - Post operative open heart surgical patient assessment before and after extubation , consist of:

A - Assessment of Respiratory system before extubation includes:

- Assessment of the initial ventilator parameter at the time of study:

- As: - Fio2 (fraction inspired oxygen)
- PEEP (positive end expiratory pressures)
- Ps (pressure support)
- Mode (SIM, Ps, spontaneous)
- Frequency (rate of inspiration)
- Vt (tidal Volume)
- Inspiratory to expiratory ratio(I:E)

B- Assessment of Respiratory system after extubation includes: Chest condition as respiratory rate, Depth, Cough (Dry or productive cough), Sputum characteristics: amount, viscosity and color, Dyspnea, Orthopnea , chest pain,pain with breathing and Auscultation findings to assess of breathing sound as (crepitating, wheezing…).

C-, Pain Postoperative numerical sternotomy scale includes (Pain at rest, Pain while taking deep breath while coughing, Pain at pulmonary function test)

Scoring: non (0) mild (1-3) moderate (4-6) sever (7-10)

D-laboratory investigation includes: CBC (complete blood count) before operation and in third day after operation

Part IV:-This part includes evaluation of respiratory system by using:

- ABG (arterial blood gas) , Six times every 4 hours in the first and second day postoperatively after extubation and three times every 8 hours in third and fourth day postoperatively.
- Pulmonary function test done (preoperative and in fourth day postoperative open heart patient).Different measurements that may be found on your report after spirometry include: Forced vital capacity (FVC),Forced expiratory volume on one second (FEV1),vital capacity (VC)
- Chest X-ray was done preoperative and in fourth day postoperative open heart surgery.

Tool two: - evaluation tool for post-operative pulmonary complications among open heart surgery patients

Comparison the effect of (conservative therapy & blow bottle) on occurrence of postoperative pulmonary complications.

Includes mission:

- Atelectasis, (through auscultation ,chest x-ray, pulmonary function test ,and blood gas)

- Pneumonia(through auscultation ,chest x-ray, and blood gas)
- Bronchitis(through auscultation ,chest x-ray, and blood gas)
- fever(through oral temperature)
- Cough with blood or sputum.

III. Methods

The study was conducted throughout three main phases, which are preparatory phase, implementation and evaluation phase:-

Preparatory phase

- An official approval and administration permission were obtained from the head of internal cardiothoracic surgery department and post-operative ICU to collect the necessary data, the aim of the study and the program was explained to them to obtain their cooperation.
- The study was approved by the local ethical committee at faculty of nursing in Assiut University.
- Protection of human rights (Ethical consideration): Informed consent was done obtained from each patient after explain the aim of the study with confidentiality of data for research purpose.
- The tools after in this study were developed by the researcher based on reviewing the related literature was done.
- Content validity: The tools were tested for content validity of research by Jury of 5 expertise from the field of staff thoracic surgery (2 professors and 1 assistant professor) and nursing educators (2 professors).
- Pilot study: A pilot study was conducted on 5 patients to test feasibility and applicability of the tools, the analysis of the pilot study revealed that minimal modifications are required. These necessary modifications were donning and the subjects were excluded from the actual study.
- The researcher was interviewing the patients individually to collect the necessary data.

Implementation and evaluation phase:-

- **Group1**: was received chest physiotherapy by conservative therapy (routine deep breathing exercise) for 5 to 10 times per day every 1 to 2 hours in second, third and fourth postoperative days. Ask the patient to repeat this procedure along the day.
- **Group2:** was received chest physiotherapy (by blow bottle) for 5 to 10 times per day every 1to 2 hours in second, third and fourth postoperative days, patient inhales slowly and deeply holding breath for 2 to 3 second after that exhale into blow bottle slowly, then after this maneuver patient done deep and coughing exercise for removing secretion. Ask the patient to repeat this procedure along the day.

For two groups :

- All patients in two groups receive analgesic before done any procedure.
- Assess gas exchange by arterial blood gas ABG (arterial blood gas), 6 times every 4/24 hour in the first two days (before extubation, after extubation and Three times every 8 /24 hour in the third and fourth day postoperatively after extubation and after done deep breathing maneuvers within 30 muint, then take mean of each day.
- Assess vital signs every two hours in:
- preoperative day (1st assessment) and four assessment postoperatively in first day
- first post-operative day(2nd assessment)
- second post-operative day(3thassessment)
- third post-operative day (4th assessment)
- And fourth post -operative day (5th assessment) , then take mean of each day.
- A comparison was done between the two groups to assess occurrence of respiratory complications in fourth day (Appendix II).
- A comparison was done between the two groups for pulmonary function test, done in preoperative day (1st assessment) and in fourth postoperative day (2nd assessment). Different measurements that may be found on your report after spirometry includes: Forced vital capacity (FVC), Forced expiratory volume on one second (FEV1), vital capacity (VC).
- Assess Postoperative sternotomy incision pain, pain measured by numerical scale: include (Pain at rest, Pain while taking deep breath, Pain while coughing, Pain at pulmonary function test)

Evaluation phase:-

- Evaluate Post-operative pulmonary complications among open heart surgical patients for two groups:
- Atelectasis, (through auscultation ,chest x-ray, pulmonary function test ,and blood gas)

- Pneumonia(through auscultation ,chest x-ray, and blood gas)
- Bronchitis(through auscultation ,chest x-ray, and blood gas)
- fever(through oral temperature)
- cough with sputum or blood

Analysis of data:

Data collected by computer programs through SPSS" version.17" Chicago. USA. Data expressed as "mean ± standard deviation" "number, percentage". Using T.test to determine significant for numeric variable.Using Chi.squire test to determine significant for non-parametric variable. Using person's correlation for numeric variable in the same group, n.s P > 0.05 no significant,P< 0.05 significant,** P < 0.01 moderate significan,*** P < 0.001 highly significant.

IV. Results

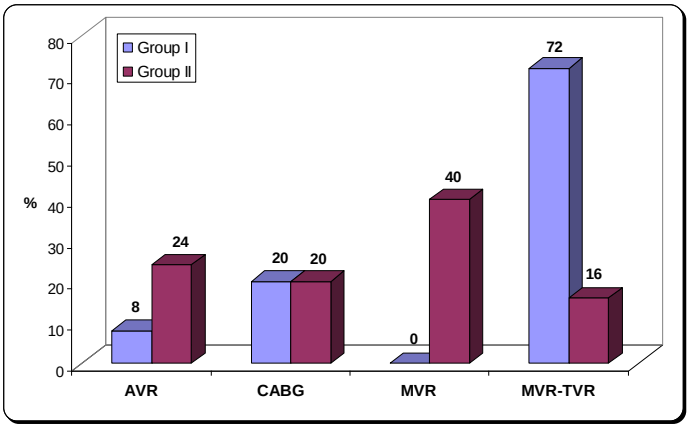
Table (1): Distribution of the Sciodemographic characteristics among the two groups

Variable	Control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Age:					
18 - 29 years	12	48.0	5	20.0	0.050*
30 - 39 years	6	24.0	13	52.0	
40 - 49 years	2	8.0	0	0.0	
≥ 50 years	5	20.0	7	28.0	
Sex:					
Male	17	68.0	19	76.0	0.529
Female	8	32.0	6	24.0	
Marital status:					
Single	15	60.0	5	20.0	0.016*
Married	9	36.0	18	72.0	
Divorced	1	4.0	2	8.0	
Educational level:					
Illiterate	14	56.0	8	32.0	0.109
Read & write	4	16.0	10	40.0	
Primary	0	0.0	2	8.0	
Preparatory	4	16.0	1	4.0	
Secondary	0	0.0	1	4.0	
University	3	12.0	3	12.0	
Occupation:					
Not working	20	80.0	11	44.0	0.038*
Farmer	2	8.0	10	40.0	
Student	0	0.0	1	4.0	
Professional	3	12.0	2	8.0	
Hospital member	0	0.0	1	4.0	

Group 1; concervative therapy, **Group 2**; blow bottle method Chi-square test

Figure (1): types of operation:

As regards types of operation 40% of patients in group 2 having MVR and 72%in group1 having MVR&TVR with significant difference between the two groups. .



AVR (aortic valve replacement**) CABG (**coronary artery bypass graft)
MVR (mitral valve replacement) **TVR (**tricuspid valve replacement**)**

Table (2): Distribution of the sample according to preoperative medical history Health habits and body measurement for two groups.

Variable	control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Health habits:					
Use tea& coffee	13	52.0	20	80.0	0.037*
Use alcohol	2	8.0	0	0.0	0.470
Smoking	4	16.0	3	12.0	0.684
Medical history:					
Cyanosis	7	28.0	12	48.0	0.145
Streptococcal infection	17	68.0	15	60.0	0.556
Rheumatic fever	18	72.0	12	48.0	0.083
Heart failure	2	8.0	9	36.0	0.017*
Allergies	2	8.0	3	12.0	0.637
dental infection	2	8.0	7	28.0	0.066
Body measurements	**Mean ± SD**		**Mean ± SD**		
Weight	62.32 ± 13.71		68.28 ± 10.25		0.080
Length	163.76 ± 7.51		162.32 ± 7.13		0.490
BMI	23.28 ± 5.13		26.02 ± 4.15		0.040*

Group 1; conservative method **Group 2**; blow bottle method

BMI (body mass index**)**

Chi-square test •Independent samples t-test * Statistical significant difference (P < 0.05)

Table (3): Distribution of the sample according to hereditary diseases for two groups.

Hereditary diseases	control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Diabetes	7	28.0	2	8.0	0.141
Renal	0	0.0	6	24.0	0.030*
Hypertension	8	32.0	14	56.0	0.087
Congenital	1	4.0	0	0.0	0.312

Group 1conservative method **Group 2**; blow bottle method

Table (4): Comparison between two groups among patient stay in ICU and Time for chest tube removal

Items	control (n= 25)	study (n= 25)	P-value
ICU stay:			0.149
Mean ± SD	4.36 ± 1.22	3.96 ± 0.61	
Range	3 – 8	3 – 5	
Time for chest tube removal:			0.853
Mean ± SD	3.76 ± 0.78	3.72 ± 0.74	
Range	3 – 5	3 – 5	

Group 1; conservative method **Group** 2; blow bottle method

Table (5): Comparison between the two studied groups in relation to vital signs during the fifth assessments (preoperative one assessment (1^{st}) and fourth assessments postoperatively.

Vital signs		control (n= 25)	study (n= 25)	P-value
		Mean ± SD	Mean ± SD	
Respiratory rate	**Pre-operative(1^{st})**	19.20 ± 2.06	17.92 ± 2.20	0.039*
	2^{nd} assessment	19.92 ± 1.78	19.20 ± 3.34	0.346
	3rd assessment	20.08 ± 1.53	18.96 ± 3.01	0.103
	4th assessment	20.80 ± 2.25	20.72 ± 2.59	0.908
	5^{th} assessment	19.96 ± 2.72	18.92 ± 2.12	0.138
Temperature	**Pre-operative(1^{st})**	36.71 ± 0.46	37.01 ± 0.36	0.014*
	2^{nd} assessment	37.02 ± 0.40	37.08 ± 0.36	0.608
	3rd assessment	37.28 ± 0.28	37.26 ± 0.19	0.765
	4th assessment	37.45 ± 0.37	37.15 ± 0.20	0.916
	5^{th} assessment	37.60 ± 0.52	37.28 ± 0.29	0.504
Heart rate(pulse)	**Pre-operative(1^{st})**	108.60 ± 16.04	110.16 ± 21.33	0.771
	2^{nd} assessment	107.00 ± 13.77	113.04 ± 16.95	0.173
	3rd assessment	97.92 ± 11.57	104.60 ± 15.87	0.096
	4th assessment	99.84 ± 11.36	96.24 ± 11.84	0.278
	5^{th} assessment	97.68 ± 7.53	97.16 ± 7.94	0.813

Group 1; conservative method **Group 2**; blow bottle method

Table (6): comparison between two groups in mechanical ventilation

(MV) data before extubation postoperatively.

item		control (n= 25)		study (n= 25)		P-value
		No.	%	No.	%	
Mode of MV	SIMV	6	24.0	10	40.0	0.225
	SPONT	19	76.0	15	60.0	
		Mean ± SD		Mean ± SD		
Fio2		38.80 ± 5.64		40.80 ± 4.00		0.155
PS		11.64 ± 2.12		10.60 ± 3.15		0.177
PEEP		5.00 ± 0.00		5.00 ± 0.00		--
F(frequency)		13.20 ± 1.61		13.16 ± 2.10		0.940

Group 1; conservative method **Group 2**; blow bottle method
Fio2 (oxy concentration) **PS** (pressure support) **PEEP** (positive end expiatory pressure)

Table (7): Assessment of respiratory system after extubation

items	control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Rate:					0.300
Normal	23	92.0	20	80.0	
Brady apnea	0	0.0	2	8.0	
Tachy apnea	2	8.0	3	12.0	
Depth:					0.234
Deep	25	100.0	22	88.0	
Shallow	0	0.0	3	12.0	
Cough:					0.047*
Yes	15	60.0	8	32.0	
No	10	40.0	17	68.0	
Color of secretion :					0.103
White	24	96.0	19	76.0	
Green	1	4.0	6	24.0	
Amount of secretion:					0.569
Mild	15	60.0	13	52.0	
Moderate	10	40.0	12	48.0	
Dyspnea:					0.713
Yes	5	20.0	4	16.0	
No	20	80.0	21	84.0	
Chest pain:					0.774
Yes	14	56.0	15	60.0	
No	11	44.0	10	40.0	

Group 1;; conservative method **Group 2**; blow bottle method

Table (8): distribution of sample according to Postoperative pain using numerical scale

Pain	control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Pain at rest					0.747
None(0)	18	72.0	19	76.0	
Mild(1-3)	7	28.0	6	24.0	
Moderate(4-6)	0	0.0	0	0.0	
Pain while taking deep breath					0.430
None(0)	1	4.0	0	0.0	
Mild(1-3)	22	88.0	21	84.0	
Moderate(4-6)	2	8.0	4	16.0	
Pain while coughing					0.007*
None(0)	0	0.0	0	0.0	
Mild(1-3)	13	52.0	4	16.0	
Moderate(4-6)	12	48.0	21	84.0	
Pain when done pulmonary function test					0.311
None(0)	0	0.0	2	8.0	
Mild(1-3)	20	80.0	17	68.0	
Moderate(4-6)	5	20.0	6	24.0	

Group 1; conservative method **Group 2**; blow bottle method

Table (9): Comparison between the two studied groups in relation to Laboratory investigations

White Blood Cells (WBCs)	control (n= 25)	study (n= 25)	P-value
	Mean ± SD	Mean ± SD	
Pre-operative(1st assessment)	6.22 ± 2.00	6.33 ± 1.80	0.830
1stday(2nd assessment)	6.55 ± 1.62	8.59 ± 2.03	0.001*
4th day(3rd assessment)	12.98±4.50	8.78 ± 2.22	0.216

Table (10): Comparison between the two studied groups in relation to arterial blood gas (ABG) during the mean fourth assessment (1st, 2nd, 3rdand the4 thday post operatively)

Arterial blood gases	control (n= 25)	study (n= 25)	P-value
	Mean ± SD	Mean ± SD	
PH:			
1st day(1st assessment)	7.42 ± 0.13	7.37 ± 0.09	0.127
2nd day (2nd assessment)	7.46 ± 0.18	7.40 ± 0.05	0.089
3rd day (3rd assessment)	7.38 ± 0.05	7.42 ± 0.05	0.017*
4th day (4th assessment)	7.41 ± 0.12	7.41 ± 0.05	0.988
$PaCO_2$:			
1st day(1st assessment)	41.37 ± 6.71	40.94 ± 6.65	0.822
2nd day (2nd assessment)	35.13 ± 5.11	35.46 ± 4.52	0.809
3rd day (3rd assessment)	37.86 ± 6.10	34.33 ± 8.83	0.107
4th day (4th assessment)	39.34 ± 5.76	36.32 ± 6.43	0.087
HCO_3:			
1st day(1st assessment)	23.96 ± 3.42	24.63 ± 3.60	0.504
2nd day (2nd assessment)	21.62 ± 3.39	21.76 ± 3.63	0.882
3rd day (3rd assessment)	21.83 ± 4.11	22.80 ± 4.97	0.455
4th day (4th assessment)	21.84 ± 4.88	21.96 ± 2.98	0.921
SaO_2:			
1st day(1st assessment)	99.21 ± 0.49	99.49 ± 0.47	0.046*
2nd day (2nd assessment)	99.02 ± 0.61	99.15 ± 0.62	0.481
3rd day (3rd assessment)	98.42 ± 1.59	99.26 ± 0.54	0.016*
4th day (4th assessment)	98.62 ± 1.43	99.00 ± 0.51	0.218
PaO_2:			
1st day(1st assessment)	187.92 ± 42.46	185.48 ± 52.01	0.857
2nd day (2nd assessment)	166.08 ± 25.40	154.68 ± 25.17	0.117
3rd day (3rd assessment)	147.28 ± 31.91	148.36 ± 27.41	0.898
4th day (4th assessment)	138.16 ± 32.95	134.80 ± 31.09	0.712

Group 1; conservative method **Group 2**; blow bottle method

Table (11): Comparison between the two studied groups in relation to pulmonary function testin preoperative day (1st assessment) and fourth day (2nd assessment) postoperatively

Pulmonary function test	control (n= 25)	study (n= 25)	P-value
	Mean ± SD	Mean ± SD	
FVC:			
Preoperative (1st assessment)	72.68 ± 12.27	78.25 ± 8.59	0.069
4th day (2nd assessment)	68.36 ± 12.74	73.46 ± 8.99	0.108
FEV1:			
Preoperative(1st assessment)	76.12 ± 14.06	87.34 ± 12.17	0.004*
4th day (2nd assessment)	72.88 ± 13.46	82.66 ± 11.29	0.008*
VC:			
Preoperative (1st assessment)	67.32 ± 7.25	69.48 ± 11.76	0.437
4th day (2nd assessment)	65.12 ± 10.10	66.53 ± 15.43	0.705

Group 1; conservative method **Group 2**; blow bottle method

FVC: forced vital, **FEV**1: forced expiratory volume in one second **VC**: vital capacity

Table (12): Comparison between the two studied groups in relation to Chest X-ray

items	control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Pneumonia	2	8.0	1	4.0	0.552
Atalectasis	3	12.0	0	0.0	0.234
Bronchitis	2	8.0	0	0.0	0.470
Secretions	12	48.0	0	0.0	0.007*

Group 1; conservative method **Group 2**; blow bottle method

Table (13): Comparison between the two studied groups in relation to complications of respiratory system in fourth day.

Complications	control (n= 25)		study (n= 25)		P-value
	No.	%	No.	%	
Pneumonia	2	8.0	1	4.0	0.602
Atalectasis	3	12.0	0	0.0	0.234
Bronchitis	2	8.0	0	0.0	0.470
Fever	6	24.0	1	4.0	0.103
Pulmonary Secretion	12	48.0	10	40.0	0.569

Group 1; conservative method **Group** 2; blow bottle method

Table (1): Scio demographic characteristics among the two groups, This table demonstrates that 52% , 48% of group 1&2 were in age group 30-39 , 18 -29 years old respectively, with significant difference between the two groups as regard age. Regard to **sex** ,it was found that no significant difference between the two groups. In relation to marital statues a significant difference between the two groups P=(0.016*).

Table (2): show preoperative medical history health habits and body measurement for two groups. Regarding to health habits it was noticed 80 % of group 2 was used **tea& coffee** with a significant difference between two groups. As regard **Medical history** the majority of group 1(72%) were having rheumatic fever .but, there were significant difference between two groups. Regarding to **body mass index** the highest percentage (26.02 ± 4.15) in group 2with significant difference between two groups.

Table (3): **hereditary diseases for two groups.** This table show that (28.0% and 56.0%) of patients having diabetes and hypertension in group1and group2respectively.. But there was a higher significant difference related to renal disease between two groups p (0.030*)

Table (4): **patient stay in ICU and Time for chest tube removal**. this table show that the mean value of time in ICU stay were (3.96 ± 0.61& 4.36 ± 1.22) days in group 2&1 respectivly with non-significance difference between two groups p(0.261).Regarding to time for chest tube removal ,There was non- significant difference between two groups.

Table (5): Comparison between the three studied groups in relation to vital signs during the fifth assessments (preoperative one assessment (1st) and fourth assessments postoperatively. This table shows that assessment of vital signs in **the two groups** in preoperative phase and postoperative phase. Concerning the respiratory rate and temperature a significant differences were found between the **two groups** during the first assessments with p-value(0.039*&0.014*) respectively.

Table (6): **mechanical ventilation (MV) data before extubation postoperatively.** This table illustrated that no significant difference was found between the two groups regarding mechanical ventilation (MV) data .

Table (7): assessment of respiratory system after extubation, regarding to assessment of respiratory system after extubation this result revealed that a significant difference were found between the two groups P(0.047*) regarding cough.

Table (8): Postoperative pain using numerical scal ,regarding to Postoperative pain it was noticed that statistical significant difference was found between the two groups P(0.001) regarding to pain while coughing.

Table (9): This table shows that Laboratory investigations in the two groups in preoperative phase and postoperative phase, Concerning the **WBCs** significant differences were found between the two groups during the second assessments in first day postoperatively with p-value (0.001).

Table (10): arterial blood gas (ABG) during the mean fourth assessment (1st, 2nd, 3rdand the4 thday post operatively), Regarding to PH it was noticed that a significant difference was found between the two groups during the third assessment (p= 0.017*). Concerning the **paco2&HCO3 statistical** no significant differences were found between the two groups during. In relation to **sao$_2$** it was found that significant difference between the two groups during the first and third assessment (p= 0.046*&0.016*) respectively, as regards **pao$_2$** no significant difference between the two groups during the fourth assessment**.**

Table (11): pulmonary function testin preoperative day (1st assessment) **and fourth day** (2nd assessment)

postoperatively, this table mention that decreased **FEV1** in fourth day postoperatively than preoperative phase with a significant difference was found between the two groups during the first and second assessment .

Table (12): reveals a comparison between the two studied groups as regards chest x-ray it was found that there was a significant difference between the two groups regarding to **secretions** P(0.007*).

Table (13): complications of respiratory system in fourth day, in this table it was found no significance difference between the two groups (12%&24%)regarding to atalectasis &fever respectively. As regard pulmonary secretion it was noticed that a highly percent 48% of patients in group 1, while 40% of patients having pulmonary secretion in group 2.

V. Discussion

Accumulation of secretions within the respiratory tract due to an ineffective airway clearance, mismatching of ventilation and perfusion, and reduced functional residual capacity are common factors contributing to impaired gas exchange in critically ill patient postoperative cardiothoracic surgery.

In the present study the mean age (18- 29) of group 1while the mean age in group 2(30-39) years old respectively, with significant difference between the two groups as regard age. Regard to **sex** ,it was found that no significant difference between the two groups. In relation to marital statues a significant difference between the two groups .

(Urell et al, 2012) [12]reported that younger patients had lower postoperative pulmonary complications after open heart surgery than older patients. This study on line with the present study.**(Hulzebos et al, 2003)** [13] reported that preoperative risk factors for postoperative pulmonary complications(PPC)were an age of more than 70 years , This study on line with the present study.

As regard type of operation the current study demonstrate that the majority was MVR &TVR in group 1 with statically significant difference between two groups. **(Tom et al, 2001)** [14] Reported that no difference between the treatment group (deep breathing with PEP) and control group for either type of surgery, this study disagreement with the present study. In relationship between type of operations and pulmonary complications the current study revealed that pulmonary complication occurs in patients having CABG.

The current study emphasized that no significant difference between two groups as regard duration of operation .the current study shows that the majority of patients preoperative treat with coronary vasodilators with significant difference between three groups.

The finding of the current study revealed that there was significant difference between two groups as regard using tea and coffee and there was significant difference between two groups regarding body mass index (BMI).

The present study demonstrated that there was no significant difference between two groups in length of ICU stay. (**Stiller and Munday, 2008)** [15] Found no significant difference in length of stay in hospital between treatment groups received regular breathing and coughing exercises, incentive spirometer or positive expiratory pressure(blow bottle). This study on line with present study, **but (Possa et al, 2013)** [16] reported that the use of incentive spirometry and positive expiratory air way pressure decrease length of hospital stay compared control group. And the present study revealed that no significant difference as regard time of chest tube removal.

Chest physiotherapy and hemodynamic parameter (vital signs)

Clinically, hemodynamic stability observed throughout the present study in the majority of the studied patients, parameters including heart rate. Concerning the respiratory rate and temperature statistical significant differences were found between the **two groups** during the first assessments .Regarding to body heart rate no statistical significant difference was found between **the two groups** during the first , third ,fourth and fifth assessment.

(Stiller et al, 2010) [17] Reported that no significant differences between 3 groups using (IS, routine chest physiotherapy and PEP) as regard temperature at any stage of treatment during fourth postoperative day. (**leigh etal ,2006**) [18] said that Respiratory rate, pulse rate, were essentially equal in all three groups. Temperature improved daily in groups using blow bottles. Those using the incentive spirometer maintained a higher temperature for a longer period.

Patient who had cardiothoracic surgery were intubated and received mechanical ventilation for extended periods often up to 24 hours or more .many institutions are currently extubated these patients earlier to prevent the adverse effects of prolonged intubation and reduce pulmonary complication, after that patient receive supplement oxygen via vent face mask or nasal cannula **(lewis ,2006)** [19].

The finding of the present study clarifies that there was no significant difference between two groups as regard mechanical ventilator parameters (mode of MV, FIO2, PS, and frequency).

The current study emphasized that there was significant difference between two groups in assessment of respiratory system after extubation as regard presence of cough, color of secretions and amount of secretions. Pain after cardiac surgery can lead to poor inspiratory effort in spontaneously breathing patient, which may contribute to postoperative pulmonary dysfunction, optimal pain relief is essential to enable the patient to perform maximal inspiration (**Morrow , 2010**) [(20)].

The present study clarifies that patients having mild pain while coughing with significant difference between two groups. **(Moreno et al, 2011)** [(21)]reported that pain may contribute to decreased cough efficiency, which is the main mechanism for the elimination of secretion from the tracheobronchial tree due to the immobility of the thoracic wall, which result in atelectasis. This result agreement with the current study, But in another study (**Westerdhl, 2004**) [(22)] reported that no significant difference between any of groups in 4th postoperative day when Pain from the sternotomy as measured by VAS.

As regard laboratory investigation the present study revealed that there was significant difference between any of groups in WBC during 2nd assessment (first day postoperative open heart surgery) and 3rd assessment (fourth day postoperative open heart surgery).

Effect of deep breathing maneuvers on gas exchange

ABG were measured immediately before extubation and before, after the deep breathing intervention on second postoperative day .the patients showed mild hypoxiam, but oxygenation improvement after preformed deep breathing intervention. The finding of the present study revealed that patient's oxygenation improved after preformed 2 deep breathing maneuvers with significant difference between two groups in 1st and 3rd day postoperatively regarding Sao_2, and significant difference between two groups in4th day regarding pao_2.

(Hofmeryr et al, 2012) [(23)] reported that there were no significant differences in arterial oxygen saturation between 2 groups**, (Stiller et al, 2010)** [(17)] reported that PaO_2 and FIO_2 were significantly reduced on the first postoperative day. By fourth postoperative day oxygenation had improved. This study in line with the present study . **(Leigh I et al ,2006)** [(18)]reported that on the third postoperative day there was a significant improvement in PaO2 in the group using blow bottles and a lesser improvement in the groups using the incentive spirometer .

(Westerdahi et al, 2004) [(24)] reported that oxygenation had slightly improved by the fourth postoperative day with no statistical difference between 2 deep breathing maneuvers (blow bottle and IS) and control group ,but small improvement in saturation (SaO_2) and pao_2 in patients performing deep breathing interventions in the 3 groups .

Effect of deep breathing maneuvers on pulmonary function test (PFT) and comparison between the 2 groups(conservative therapy &blow bottle) Reduction in lung volumes and oxygenation are common during the initial period after open heart surgery. The effects of the median sternotomy, hypothermia for myocardial protection, dissection of internal mammary artery and the use of cardio pulmonary by pass negatively influence lung function **(Banmgarten et al., 2009)** [(25)].

In comparison to preoperative value the current study showed that mean reduction observed in forced vital capacity (FVC), forced expiratory volume in1 second (FEV1) &vital capacity (VC) on fourth postoperative day compered to preoperative day. And the current study clarifies that a statically significant difference between two groups regarding to expiratory volume in1 second(FEV1) with improved in(FVC ,FEV& VC) in patients preforming deep breathing with blow bottle than routine deep breathing and coughing exercise .

There are many studies supported this finding,(Jenkins et al, 2012) [(26)]said that the pulmonary function after CABG were severely reduced in all treatment groups on the fourth post-operative day with a mean 60 – 75% of the pre-operative values.

(Ragnarsdotti, 2004) [(27)] showed that a 33% decrease in pulmonary function on postoperative day 3 and a 23% on postoperative day 6 compared to the preoperative period.**(Moreno et al, 2011)** [(21)] reported that pulmonary function decreased after CABG, pulmonary function was the worst on postoperative day 3 and began to improve on postoperative day 15.

(Weissman, 2010) [(28)] reported that after cardiac surgery, there are decreases in forced vital capacity (FVC), expiratory volume in the first second of forced expiration (FEV_1) and maximum voluntary ventilation than preoperative period. **(Gale and Sander, 2000)** [(29)] reported that is improved the lung function when patients using PEP (blow bottle) compared to other physical therapy intervention.

(WesterdahI et al, 2001) [(10)]reported that blow bottle group had significantly less reduction in total lung capacity ($P = 0.01$) compared to the deep breathing group and reported that impairment in pulmonary function tended to be less marked using the blow bottle technique.

(Stockc et al, 2010) [30] reported that patients who undergo upper abdominal and cardiac surgery operations experience proportional decreases in all lung volumes without clinically significant changes in FEV_1, FVC, but patients received IS had more rapid recovery of VC than those who received conservative therapy, but the two groups treatment groups showed similar improvements in FVC and FEV.**(Nicholson et al ,2010)** [31]reported that a mean reduction on FVC &FEV to be 40-50 % on the first to third postoperative day, on the second day a mean reduction of 63 % in vital capacity compered to preoperative day .

The current study revealed that 12% &48% in group 2 having atalactasis and pulmonary secretions as regard x-ray ,this result supported by (**westerdahI et al ,2001**) [10] who reported that The incidence and severity of chest roentgen logical sign of atelectasis in the left and right lung, about [9 in the blow bottle, 12 in deep breathing group] with no significant differences among the three groups on the occurrence of atelectasis in the left lung (P = 0.97) or in the right lung (P = 0.73).

As regarded pleural effusions pleural effusion 19 were in the blow bottle group and 27 in the deep breathing group.

Chest physiotherapy

Chest physiotherapy is a bronchial hygiene used to prevent accumulation of pulmonary secretions, mobilization of these secretions, improve the cough mechanism, and improve efficiency and distribution of ventilation **(university of Rochester , 2012)** [32]**.** Several methods have been studied, including positive pressure breathing, deep breathing exercise, and incentive spirometer. (**Davido&Warner, 2012)** [33], Postoperative maneuvers to increase mean lung volumes are proven benefit in preventing PPCS, this techniques increase lung expansible forces and discourage atelectasis.

Effect of deep breathing maneuvers on pulmonary complications and comparison between the 2groups (blow bottle& conservative therapy) The present study confirmed that the majority of complications 8%, 12%, 8%,24% &80% having pulmonary complications (pneumonia ,atalectsais, bronchitis ,fever and pulmonary secretions) respectively in group1(conservative therapy) with no statistical significant difference between 2 groups in pulmonary secretions .

This result concluded that using of deep breathing exercise with blow bottle and more effective for decreasing pulmonary complications for patients under open heart surgery**.**

Positive expiratory pressure (PEP) blow bottle

The blow bottle is a cheap and simple and easily learned by method of producing appositive expiratory pressure. The uses of blow bottle in postoperative care are aimed at increasing the pulmonary volume and facilitating the release of pulmonary secretion and reduce pulmonary complications after open heart surgery. The blow bottle is still used as the most economical device available in the clinical practice which surrogated the PEP effect.

The theoretical benefit of PEP is the ability to chance and promote mucus clearance by either preventing air way collapse by setting the air way or increasing intrathoracic pressure distal to retained secretions by collateral ventilation or by increasing functional residual capacity (FRC). Optimize the breathing pattern and improve oxygenation **(Layon et al 2000-Breathe, 2009)** [34].

Blow bottles are used in many western Ear open countries for several reason **(Mahlmeister, 2005)** [35]in our study we found no major differences between patients performing deep breathing with or without a mechanical device but in blow bottle group had a small better in TLC and tendency to less reduction FRC and FEVI than deep breathing group on the fourth postoperative day.

(Hofmeyr et al, 2012) [23]during treatment reported that patient treat with positive expiratory pressure produced mild sputum than groups receiving routine deep breathing produced more sputum.**(Sehlin et al 2007)** [36] reported that chest physiotherapy after CABG with PEP bottle and PEP mask decrease the rate of pulmonary complications.

(Ingwersen et al 2005) [9]compare the effect of post-operative PEP blow bottle device and routine chest physiotherapy only one study showed the effects of PEP **(Ricksten et al)** [36]than incentive spirometery on prevention of atelectasis, oxygenation and lung volumes.

(Shelin et al,2007) [36]reported that the most commonly used PEP device was the blow bottle system to prevent pulmonary postoperative complications after abdominal and thoracic surgery. **(Leigh I et al, 2006)** [18] reported that the incidence of significant atelectasis was lowest in the group using blow bottles (8%) and (15%) in the group using the incentive spirometer group.

(Westerdahi, 2001) [10]conclude that the relative decrease in pulmonary function tended to be less marked by chest physiotherapy using the blow bottle technique than by deep breathing without any mechanical device. And reported that a significant decrease of atelectatic area, increases in aerated lung area were found after performance deep breathing exercise with mechanical device (blow bottle).

(Orman&Westerdahl, 2010) [(1)]reported that PEP treatment us better than other physiotherapy breathing technique in patients undergoing abdominal or thoracic surgery on occurrence of respiratory complication. **(Stock et al, 2010)** [(37)]reported that patients using respiratory therapy with or without devices are associated with decreased incidence of postoperative pneumonia and atelectasis.

(Westerdahl et al, 2003) [(38)]reported that reduced lung volumes affects gas exchange and an inverse correlation between a tectectatic area and arterial oxygenation (PaO_2) during first four days after open heart surgery, but improved by positive deep breathing exercise after weaning from mechanical ventilation using incentive spirometer or blow bottles.

(Brage et al 2009) [(39)]showed that preoperative respiratory physiotherapy in significantly related to a lower incidence of atelectasis postoperatively of CABG by IS, deep berating exercises.

(Johansson et al ,2013) [(40)] Reported that the common first-choice PEP devices were the Blow bottle system.

VI. Conclusion

Based on the results of the current study it can be concluded that a positive effects of PEP (blow bottle) compared with other physiotherapy breathing techniques on occurrence of pulmonary complications among open heart patients postoperatively. Significant restrictive decrease in pulmonary function was present on the fourth postoperative day after CABG rather than preoperative day. Pain from the sternotomy was low and could not explain the impairment. Major differences were found between patients performing deep breathing exercise alone and deep breathing with a blow bottle during the first four postoperative days. Patients who performed deep breathing exercises with a blow bottle device postoperatively showed a significantly smaller amount of atelectasis, improved oxygenation and had less reduction in FVC and FEV1 on the fourth postoperative day compared to conservative therapy. Regarding to secretions the study revealed that patients who performed deep breathing exercises with a blow bottle device having small amount of secretions with statistical significant difference between the two groups.

Recommendations

Based on the finding of the current study, the following recommendations are suggested:

- Provide training program to update critical care nurses knowledge and skill about new maneuvers of deep breathing.
- Available critical care nurse especial for chest physiotherapy (physiotherapist) must be present in ICU. There is a great need for researches to identify the best method s for providing chest physiotherapy to critical ill patients after extubation to prevent fetal complication.
- Repeat this research on a large sample size to evaluate effect of chest physiotherapy on preventing of respiratory complications after open heart surgery.
- Instructing the patient chest physiotherapy procedures preoperatively to allow understanding what should be done and why.
- Portable pulmonary function test should be available in ICU and training the Critical care nurse about how to use it.
- Explain to the nurse the deference between deep breathing exercise alone and deep breathing exercise with anther maneuver such as blow bottle device, and the effectiveness on respiratory system for preventing respiratory complictions.

References

[1]. **Westerdahi L&Orman J**,(2010): chest physiotherapy with postoperative expiratory pressure breathing after abdominal and thoracic surgery; 54;461 –467.

[2]. **KulaylatMN&Dayton MT (2012):** Surgical complications. Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice. Philadelphia, PA: Saunders Elsevier;276 -282.

[3]. **Hery M& Thompson J**, (2005): clinical nursing surgery; Edinburgh; Saunders: 252.

[4]. **SchullerD&Marrow LE**, (2007) pulmonary complications after coronary revascularization curropin, cardio ; 15 (5): 309 – 15.

[5]. **Bartlett RH, Gazzaniga AB&Geraghty TR**. (2010): Respiratory maneuvers to prevent postoperative pulmonary complications. A critical review. JAMA; 224(7):1017-1021.

[6]. **Duggan M& Kavanagh BP**.(2010): Perioperative modifications of respiratory function. Best Pract Res ClinAnaesthesiol.; 24(2):145-55.

[7]. **Curley M, Moloney I& Harmon P**,(2006): critical care Nursing, 5th ed., Philadelphia: Sanders company ; 208 – 212.

[8]. **Johansson H, Sjoholm R, Statberg A & Westerdahl E (2013),** breathing. Exercise with positive expiratory pressure after abdominal and thoracic surgery – the current physical therapy practice in Sweden volume 4(6).

[9]. **Igwersen UM, Larsen KR, Bertelsen MT, Kiil-Nielsen K, Laub M, Sandermann J**.(2005):Three different mask physiotherapy regimens for prevention of post-operative pulmonary complications after heart and pulmonary surgery. Intensive Care Med; 19:294-298.

[10]. **Westerdeh E&Lindmark B**, (2001): Chest physiotherapy after coronary artery bypasses graft surgery. A comparison of three different deep breathing;30:66-72.

[11]. **Savci S, Sakinc S, inal D, Arikan H, Can Z, Buran Y &Kuralay E ,**(2006): active cycle of breathing techniques and incentive spirometer in coronary artery bypass graft surgery 17 (2) : 64 – 69.

[12]. **Urell C, Hedentrom H, Westerdahl E, Janson C &Emtner M,** (2012): lung function before and two days after open-heart surgery ; 23: 1 – 7.
[13]. **Hulzebos E, Van Mceteren N, De Bie R, Dagnelie P &helders D**(2003): prediction of postoperative pulmonary complications on the basis of pre-operative risk factors in patients who had undergone coronary artery bypass graft surgery. 83(1); 8 – 16.
[14]. **Tom J, Overend, Catherine M, Anderson, Deborah Lucy L Christina B&Timmernan**S, (2001), The effect of incentive spirometry on postoperative pulmonary complications; 120 (3): 971 – 978.
[15]. **Stiller k&Munday R (2008)**: Chest physiotherapy for the surgical patient ; (79): 745 – 749.
[16]. **Possa S, Amador B, Gosta A, Sakamoto E, Kondos, Vasconcellos M and Brito M** ,(2013): vol. 29; 1 – 9.
[17]. **Stiller k, Montarello J, Walace M, Daff M, Grant R, Jenkins S, Hall B, Yates H &Nurs B** (2010) efficacy of breathing and coughing exercises in the prevention of pulmonary complications after coronary artery surgery 105 : 741 – 47.
[18]. **Leigh I, Ieverson M, Roger R, Ecker N, Harold E., Fox M & Ivan A**, (2006) ;three different mask physiotherapy regimens for prevention of postoperative pulmonary complication after heart and pulmonary surgery. Intensive care Med: (25) 197 – 200.
[19]. **Lewis C**, (2006): Encyclopedia of respiratory medicine oxygen therapy: 278 – 82.
[20]. **Morrow LE**,(2010) pulmonary complications after coronary bypass graft;51:215-218.
[21]. **Moreno A, Castro R, Sorares P, Anna M, Cravo S &Nobrega A,(** 2011): Longitudinal evaluation the pulmonary function of the pre and postoperative periods in the coronary artery bypass graft surgery of patients treated with physiotherapy protocol 6 : 62.
[22]. **Westerdahl E. Lindmark B, Almgren So, et al**,(2004) :chest physiotherapy after coronary artery bypass graft surgery comparison of three different deep breathing techniques, J Rehabil med ; 33: 79 – 89.
[23]. **Hofmeyr JL, Webber BA &Hodsonme** (2012), evaluation of positive expiratory pressure as an adjunct to chest physiotherapy in the treatment of cystic fibrosis, 41: 951 – 954.
[24]. **Baumgarten M, Garcia G &Frantzeski**, (2009): pain and pulmonary function in patients submitted to heart surgery via sternotomy (Brazilian) journal of cardio vascular surgery 271(4); 497 – 505.
[25]. **Jenkins SC, soutar SA, forsyth A, Keates JR &Moxham J**, (2012): Lung functions after coronary artery surgery using the internal mammary artery and the saphenous vein. Thorax; 44: 209 – 211.
[26]. **Ragnarsdotti M, Kristjansdottir A, Ingvarsdottil ,Hannesson P &Torfason B**,(2004) : Short tern changes in pulmonary function and respiratory movements after cardiac surgery via median sternotmy 38 (1): 46 – 52.
[27]. **Weissman C**,(2004);pulmonary complications after surgery. 8(3); 185 – 211.
[28]. **Gale GD& Sanders DF**(2000) incentive spirometery value after cardiac surgery Anesth socj, 27 (5): 343 – 50.
[29]. **Stock C, John B, Downs M, Pauk, Joan M, Alster M, & Peter B (**2010): prevention of postoperative pulmonary complications with CPAP, incentive spirometer and conservative therapy 87: 151 – 157.
[30]. **Nicholson J, Kowalski E, Hamilton G, Meyers P, Serrette C and Duke P,** (2010): postoperative pulmonary function in coronary artery bypass graft surgery patients undergoing early tracheal estuation. A comparison between short term mechanical ventilation and early extubation, journal of cardiothoracic and vascular anesthesia ;6 (1): 27 – 31.
[31]. **University of Rochester Medical center**, (2013): open heart surgery.
[32]. **David O& Warner MD**, (2012): preventing postoperative pulmonary complications, (Lippicott Williams Wilkins) 92(5) :1967 – 72.
[33]. **Layon J, Bannor MJ, Haeger MJ, Peterson CV& Gallagher TJ,** (2000) :continuous positive air way pressure and expiratory positive pressure increase functional residual capacity equivalently chest 89; 517 – 521.
[34]. **Mahlmeister MJ, fink JB, Hoffman GL& Fifer L**F,(2005): Positive-expiratory pressures mask therapy: theoretical and practical consideration and review of the literature. Respiratory care; 36: 1218 – 1230.
[35]. **Shelin M, Ohberg F, Johnsson G, &Winso O** ,(2007) Physiological responses to positive expiratory pressure breathing, A comparison of the PEP bottle and PEP mask52 (8): 1000 – 1005.
[36]. **Westerdahl E, Lindmark B, Eriskssont , Hedenstierna G, &Tenling A** ,(2003): the immediate effects of deep breathing exercises on atelectasis and oxygenation after cardiac surgery 37 (6): 363 – 7.
[37]. **Brage YL, Fernandez SP, Stein Ad, Gonzalez VM, Diaz SP and Garcia AM** (2009) respiratory physiotherapy and incidence of pulmonary complications off pump coronary artery bypass graft surgery;9(36); 1186 – 1971.
[38]. **Johansson etal**,(2013) .Breathing Exercises with Positive Expiratory Pressure after Abdominal Surgery–The Current Physical Therapy Practice in Sweden 4-9.
[39]. **Bjerke, N. B**. (2004). The evolution: Handwashing to hand hygiene guidance. Critical Care Nursing Quarterly, 27, 295–307.
[40]. **Yane – Bragel, Pila – Fernandes, Juffe- SleinA ,Marhne. Gonzale U, Perlega Diaz S &Mauleon Garcia A** (2009), Respiratory physiotherapy and incidence of pulmonary complications in off pump coronary artery bypass graft surgery an observational follow-up study. BMC pulmonary Med,: 9: