AIM OF THE WORK

The aim of this work was to study the effects of inhaled milrinone versus inhaled nitroglycerin on pulmonary and systemic haemodynamics in children with pulmonary hypertension associated with acyanotic congenital heart disease undergoing cardiac catheterization.

PATIENTS

This prospective randomized study was carried out in the pediatric cardiac catheterization centre at El-Shatby Pediatric Alexandria university hospital after approval of the medical ethical committee. Each parent received verbal and plain language written description of the research protocol and informed consent were taken from the parents.

Thirty six children below age 4 years suffering from acyanotic congenital heart disease and left to right shunt with pulmonary hypertension [defined by mean pulmonary arterial pressure exceeds 25 mmHg at rest or 30 mmHg during exercise] who required pediatric cardiac catheterization were enrolled prospectively to participate in this study (according to Medcalc Software 8.1). [86]

Patients were randomized into two equal groups using closed envelope method.

- **Group I:** Patients received inhaled nitroglycerin in oxygen.
- **Group II:** Patients received inhaled milrinone in oxygen.

Exclusion criteria:

Patients with:

1- Coagulopathy.
2- Cyanotic heart disease.
3- Those receiving sedative drugs.
4- Those requiring mechanical ventilation.
5- Those on inotropic drugs.
6- Those requiring supplemental oxygen.
7- Left heart obstructive lesion.
8- Severe left ventricular dysfunction.
9- Severe pulmonary or tricuspid valvular regurgitation.
10- Trisomy 21.
11- Eisenmenger syndrome.
12- Those already receiving vasodilator treatment.
13- Primary pulmonary hypertension.

METHODS

In order to fulfill the selection criteria, every patient was subjected to a careful preanaesthetic assessment including:

1- History taking as regards current medical illness, drug therapy and previous experience with general or local anaesthesia if any.
2- Clinical examination, laboratory investigations and echocardiography.

Anaesthetic technique

Standard anaesthetic technique was used in all the patients. After application of EMLA cream, intravenous line was inserted. Monitors were attached which include ECG leads, pulse oximeter and noninvasive blood pressure cuff. Injection midazolam (0.01mg/kg) was given intravenous 2 minutes before the induction of anaesthesia. Anaesthesia was induced using propofol 1.5mg/kg and fentanyl 2μg/kg as IV bolus doses. Maintenance of anaesthesia was achieved with infusion of propofol 2mg/kg/h and fentanyl 2 μg/kg/h and respiration was maintained spontaneously with a laryngeal mask of proper size.

Patients were randomized into two equal groups:

Group I: Patients received nebulized nitroglycerin in the dose of 2.5 μg/kg/min for a period of 10 min (i.e. 25μg/kg of nitroglycerin was needed during the 10 min period). Nitroglycerin 5mg (5ml of 1mg/ml) was dissolved in 20ml normal saline to make a solution of 250μg/ml of drug. The required amount of nitroglycerin was taken with the help of 1ml syringe bearing marks for each 0.1ml, so that 25μg of drug was taken precisely, then 0.1ml of dissolved drug was taken for every 1 kg body weight of patient (i.e. 0.5ml for a 5 kg child) and made up to 3ml with normal saline and nebulized after induction of anaesthesia using 5-6 litre/min of oxygen.

Group II: Patients received nebulized milrinone in the dose of 2.5μg/ kg/min for a period of 10 min (i.e. 25μg/kg of milrinone was needed during the 10 min period). Milrinone 5mg (5ml of 1mg/ml) was dissolved in 20ml normal saline to make a solution of 250μg/ml of drug. The required amount of milrinone was taken with the help of 1ml syringe bearing marks for each 0.1ml, so that 25μg of drug was taken precisely, then 0.1ml of dissolved drug was taken for every 1 kg body weight of patient (i.e. 0.5 ml for a 5 kg child) and made up to 3ml with normal saline and nebulized after induction of anaesthesia using 5-6 litre/min of oxygen.

If 20–30% reduction from baseline in systolic blood pressure occurred, it was treated with IV Dobutamine 10μg/kg/min for 10 minutes. [87]

Measurements

A- The following data were recorded for each patient in all groups:

1- Demographic data (age, sex and bodyweight).
2- Haemodynamic variables:

   a- After induction and femoral access insertion: heart rate, systolic, diastolic and mean systemic arterial blood pressures were recorded for all patients noninvasively while pulmonary artery pressures were recorded for all patients invasively. These measurements were taken as a baseline values.
   b- Drug was prepared and nebulized for 10 minutes then measurements were taken again 15 minutes after drug administration.
   c- Haemodynamic data was obtained using MAC-LAB 6H, cath lab haemodynamic monitoring system (1996 Marquette Medical Systems Inc., now a part of GE Healthcare worldwide), which provide the electronic mean of all haemodynamic variables.

3- Samples of blood were collected from the superior vena cava, pulmonary artery (PA) and femoral artery in heparinized syringes to measure:

   a- Saturation and partial pressure of oxygen representing systemic venous, pulmonary arterial and systemic arterial blood respectively. As pulmonary veins could not be entered during cardiac catheterization study, pulmonary venous saturation was substituted with systemic arterial saturation as there was no right to left shunt in any of the patients.

   b- These samples were taken after induction and femoral access insertion as a baseline values then drug was prepared and nebulized for 10 minutes then samples were taken again 15 minutes after drug administration.

4- Pulmonary vascular resistance index (PVRI), systemic vascular resistance index (SVRI) and pulmonary to systemic blood flow ratio (Qp/Qs) were calculated using standard formulas based on Fick's principle through computerized program. [88] These variables were calculated after induction and femoral access insertion as a baseline values then drug was prepared and nebulized for 10 minutes then these variables were calculated again 15 minutes after drug administration. Data was obtained using MAC-LAB 6H, cath lab haemodynamic monitoring system (1996 Marquette Medical Systems Inc., now a part of GE Healthcare worldwide).

Statistical analysis of the data [89, 90]

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using number and percent.

Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Comparison between different groups regarding categorical variables was tested using Chi-square test.

The distributions of quantitative variables were tested for normality using Kolmogorov-Smirnov test, Shapiro-Wilk test and D'Agstino test, also Histogram and QQ plot were used for vision test. If it reveals normal data distribution, parametric tests were applied. If the data were abnormally distributed, non-parametric tests were used.

For normally distributed data, comparison between two independent populations were done using independent t-test, also paired t-test was used to analyse two paired data, comparison between different periods using ANOVA with repeated measures and Post Hoc test was assessed using Bonferroni adjusted.

For abnormally distributed data, comparison between two independent populations was done using Mann Whitney test. To compare between the different periods Wilcoxon signed ranks test was applied.

Significance test results were quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

RESULTS

The present study was carried on 36 pediatric patients of both sex aged below 4 years scheduled to undergo pediatric cardiac catheterization.

Results of the present study showed:

Demographic data

Age: (months) (table 4, figure 4)

In group I, the mean value was 28.33 ± 16.61 while in group II, the mean value was 27.17 ± 13.91. Comparison between the two groups revealed no statistically significant difference (P=0.823).

Sex: (M/F) (table 5, figure 5)

In group I, it included 18 patients, 50% females and 50 % males while in group II, it included 18 patients, 55.6% females and 44.4% males. Comparison between the two groups revealed no statistically significant difference (P=0.738).

Body weight: (Kgs) (table 6, figure 6)

In group I, the mean value was 11.14 ± 3.74 while in group II, the mean value was 10.53 ± 3.21. Comparison between the two groups revealed no statistically significant difference (P=0.602).

Table (4): Age in the two studied groups (months)

Case number	Group I	Group II
1	17	18
2	12	42
3	42	10
4	42	47
5	15	18
6	47	47
7	47	36
8	8	24
9	17	42
10	10	15
11	47	42
12	47	9
13	28	34
14	4	18
15	24	42
16	12	12
17	47	15
18	44	18
Min. – Max. Mean ± SD. Median	4.0 – 47.0 28.33 ± 16.61 26.0	9.0 ─ 47.0 27.17 ± 13.91 21.0
Z	0.223	
p	0.823	

Z: Z for Mann Whitney test
P value significant if ≤0.05

Table (5): Sex in the two studied groups (M/F)

Case number	Group I	Group II
1	Male	Female
2	Female	Male
3	Male	Female
4	Male	Male
5	Female	Female
6	Male	Male
7	Female	Male
8	Female	Female
9	Female	Male
10	Male	Female
11	Male	Male
12	Male	Female
13	Female	Female
14	Female	Male
15	Male	Male
16	Male	Female
17	Female	Female
18	Female	Female
Male **Female**	9 (50.0%) 9 (50.0%)	8 (44.4%) 10 (55.6%)
χ^2	0.111	
p	0.738	

χ^2: Chi square test
P value significant if ≤0.05

Table (6): Body weight in the two studied groups (kgs)

Case number	Group I	Group II
1	8.5	10
2	7.5	14
3	13	8
4	15	15
5	6.5	9
6	15	15
7	15	13
8	6	10
9	5.5	12
10	6.5	6.5
11	15	13
12	15	5
13	13	11
14	12	11
15	14	15
16	7	7.5
17	12	6.5
18	14	8
Min. – Max. **Mean ± SD.** **Median**	5.50 – 15.0 11.14 ± 3.74 12.50	5.0 – 15.0 10.53 ± 3.21 10.50
t	0.526	
p	0.602	

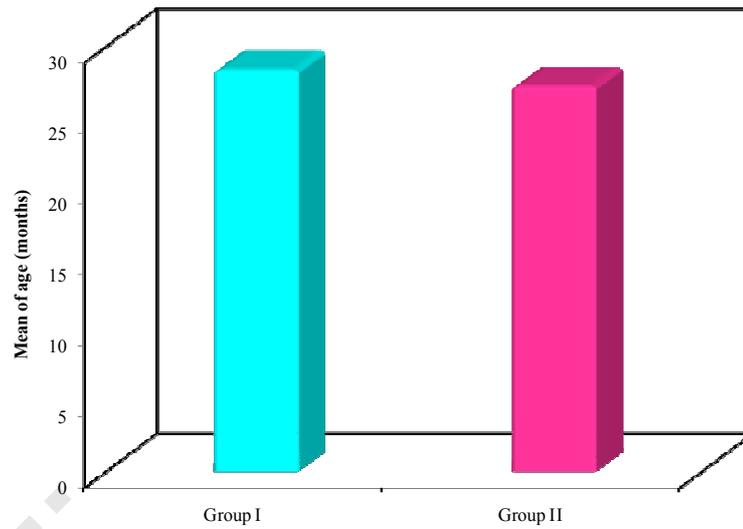t: Student t-test

P value significant if ≤0.05

Figure (4): Age in the two studied groups (months)
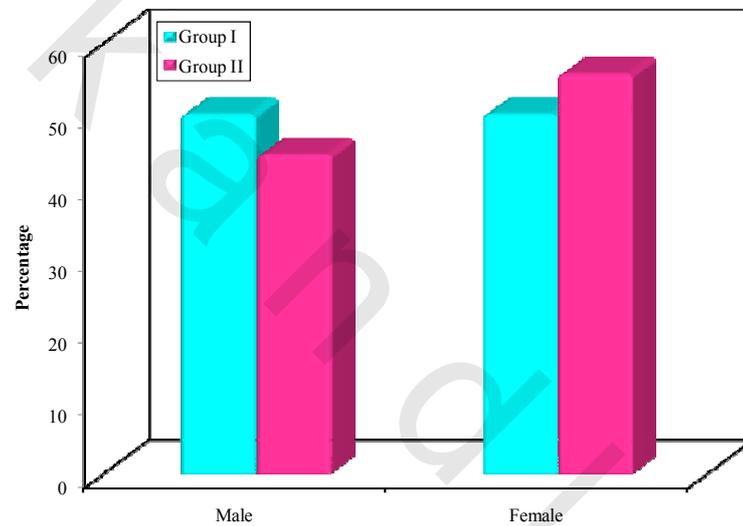
Figure (5): Sex in the two studied groups (M/F).
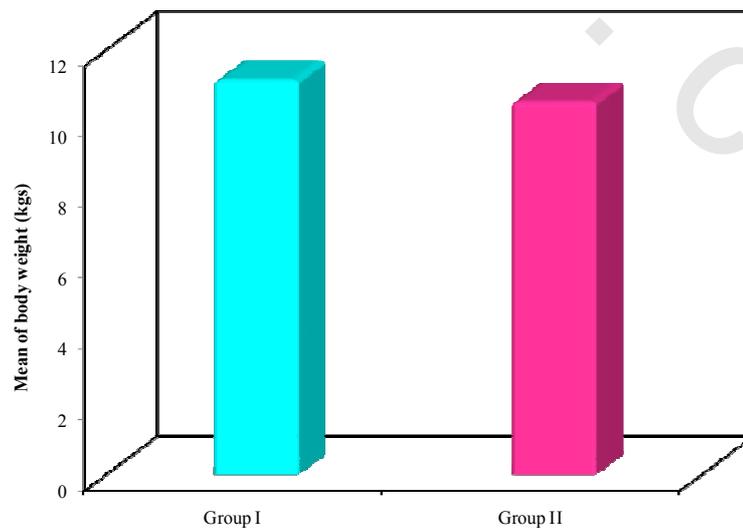
Figures (6): Body weight in the two studied groups (kgs).

Heart rate changes: (beats/min) (tables 7,8,9, figure 7)

In group I, At preinduction, it was 124.83 ± 11.37. 5 minutes after induction (as baseline), it decreased significantly to a mean of 117.11 ± 11.75. 15 minutes after drug administration, it decreased insignificantly to a mean of 116.39 ± 11.60.

In group II, At preinduction, it was 120.56 ± 10.0. 5 minutes after induction (as baseline), it decreased significantly to a mean of 109.17 ± 13.0. 15 minutes after drug administration, it decreased insignificantly to a mean of 108.72 ± 11.81.

Comparison between the two groups revealed no statistically significant difference at preinduction, 5 minutes after induction and 15 minutes after drug administration (p=0.239,0.063,0.380 respectively).

Table (7): Heart rate changes in group I (beats/min)

Case number	Pre-I	After 5	After 15
1	130	120	118
2	120	115	115
3	116	109	107
4	118	110	112
5	135	130	128
6	110	100	102
7	119	110	111
8	130	125	123
9	140	135	135
10	128	122	124
11	121	114	113
12	115	110	108
13	145	133	133
14	125	120	118
15	112	102	100
16	149	140	138
17	115	105	104
18	119	108	106
Min. – Max. **Mean ± SD.** **Median**	110.0 – 149.0 124.83 ± 11.37 120.50	100.0 – 140.0 117.11 ± 11.75 114.50	100.0 – 138.0 116.39 ± 11.60 114.0
p₁		$<0.001^*$	$<0.001^*$
p₂		0.200	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \le 0.05$

Table (8): Heart rate changes in group II (beats/min)

Case number	Pre-I	After 5	After 15
1	120	107	105
2	118	105	107
3	130	123	120
4	115	100	103
5	130	121	119
6	119	113	112
7	100	88	89
8	112	99	98
9	118	101	102
10	142	138	135
11	113	98	99
12	140	134	132
13	117	102	103
14	120	105	103
15	115	98	100
16	120	108	106
17	125	115	116
18	116	110	108
Min. – Max.	100.0 – 142.0	88.0 – 138.0	89.0 – 135.0
Mean ± SD.	120.56 ± 10.0	109.17 ± 13.0	108.72 ± 11.81
Median	118.50	106.0	105.50
p_1		<0.001*	<0.001*
p_2		1.000	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (9): Heart rate changes in the two studied groups (beats/min)

	Pre-I	**After 5**	**After 15**
Group I			
Min. – Max.	110.0 – 149.0	100.0 – 140.0	100.0 – 138.0
Mean ± SD.	124.83 ± 11.37	117.11 ± 11.75	116.39 ± 11.60
Median	120.50	114.50	114.0
Group II			
Min. – Max.	100.0 – 142.0	88.0 – 138.0	89.0 – 135.0
Mean ± SD.	120.56 ± 10.0	109.17 ± 13.0	108.72 ± 11.81
Median	118.50	106.0	105.50
t	1.119	1.923	0.889
p	0.239	0.063	0.380

t: Student t-test
P value significant if ≤0.05
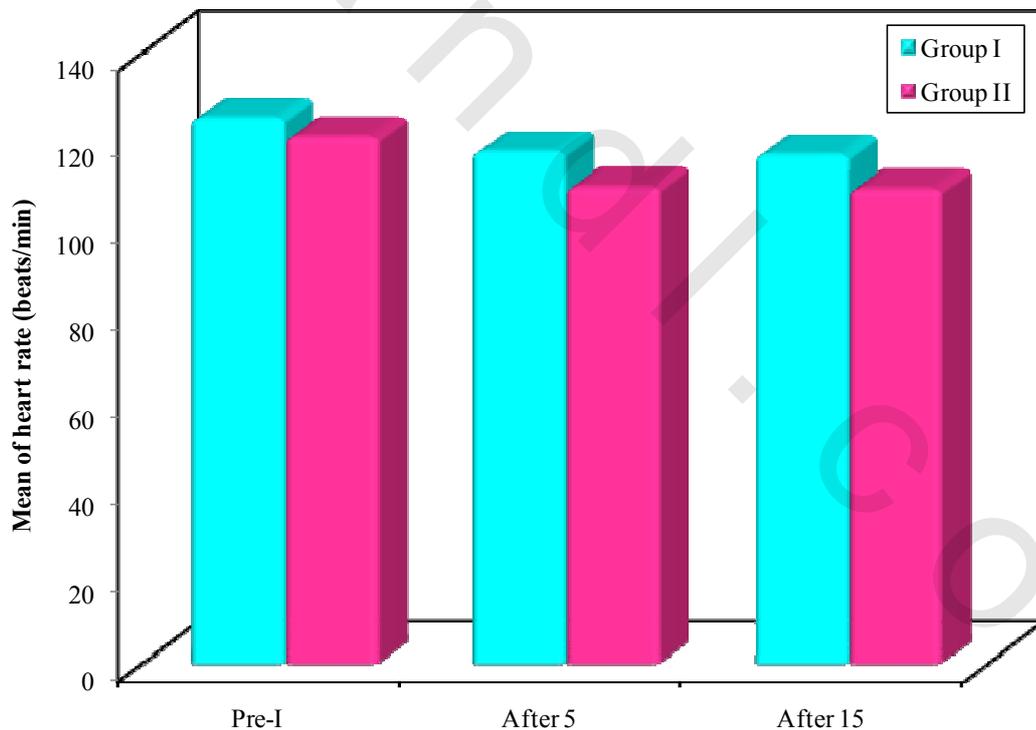
Figure (7): Heart rate changes in the two studied groups (beats/min).

Systolic arterial blood pressure Changes: (mmHg) (tables 10, 11, 12, figure 8)

In group I, At preinduction, it was 86.33 ± 16.64. 5 minutes after induction (as baseline), it decreased significantly to a mean of 80.11 ± 16.60. 15 minutes after drug administration, it decreased insignificantly to a mean of 79.61 ± 15.57.

In group II, At preinduction, it was 81.50 ± 15.96. 5 minutes after induction (as baseline), it decreased significantly to a mean of 74.0 ± 13.89. 15 minutes after drug administration, it decreased insignificantly to a mean of 73.78 ± 14.26.

Comparison between the two groups revealed no statistically significant difference at preinduction, 5 minutes after induction and 15 minutes after drug administration (p=0.380,0.239,0.249 respectively).

Table (10): Systolic arterial blood pressure changes in Group I (mmHg)

Case number	Pre-I	After 5	After 15
1	65	61	60
2	70	65	60
3	110	106	100
4	66	60	65
5	85	80	82
6	81	78	80
7	94	90	93
8	96	91	85
9	85	79	75
10	110	100	100
11	77	69	70
12	117	107	106
13	70	63	65
14	100	95	96
15	63	55	60
16	79	70	68
17	100	97	95
18	86	76	73
Min. – Max. **Mean ± SD.** **Median**	63.0 – 117.0 86.33 ± 16.64 85.0	55.0 – 107.0 80.11 ± 16.60 78.50	60.0 – 106.0 79.61 ± 15.57 77.50
p₁		<0.001*	<0.001*
p₂		1.000	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (11): Systolic arterial blood pressure changes in Group II (mmHg).

Case number	Pre-I	After 5	After 15
1	116	107	106
2	110	89	90
3	79	68	66
4	99	88	86
5	63	58	53
6	75	67	65
7	100	95	94
8	83	76	74
9	70	63	60
10	87	80	82
11	78	70	72
12	64	58	57
13	71	63	64
14	80	73	75
15	65	62	64
16	90	85	87
17	66	63	64
18	71	67	69
Min. – Max. **Mean ± SD.** **Median**	63.0 – 116.0 81.50 ± 15.96 78.50	58.0 – 107.0 74.0 ± 13.89 69.0	53.0 – 106.0 73.78 ± 14.26 70.50
p₁		<0.001*	<0.001*
p₂		1.000	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (12): Systolic arterial blood pressure changes in the two studied groups (mmHg)

	Pre-I	**After 5**	**After 15**
Group I			
Min. – Max.	63.0 – 117.0	55.0 – 107.0	60.0 – 106.0
Mean ± SD.	86.33 ± 16.64	80.11 ± 16.60	79.61 ± 15.57
Median	85.0	78.50	77.50
Group II			
Min. – Max.	63.0 – 116.0	58.0 – 107.0	53.0 – 106.0
Mean ± SD.	81.50 ± 15.96	74.0 ± 13.89	73.78 ± 14.26
Median	78.50	69.0	70.50
t	0.889	1.198	1.172
p	0.380	0.239	0.249

t: Student t-test
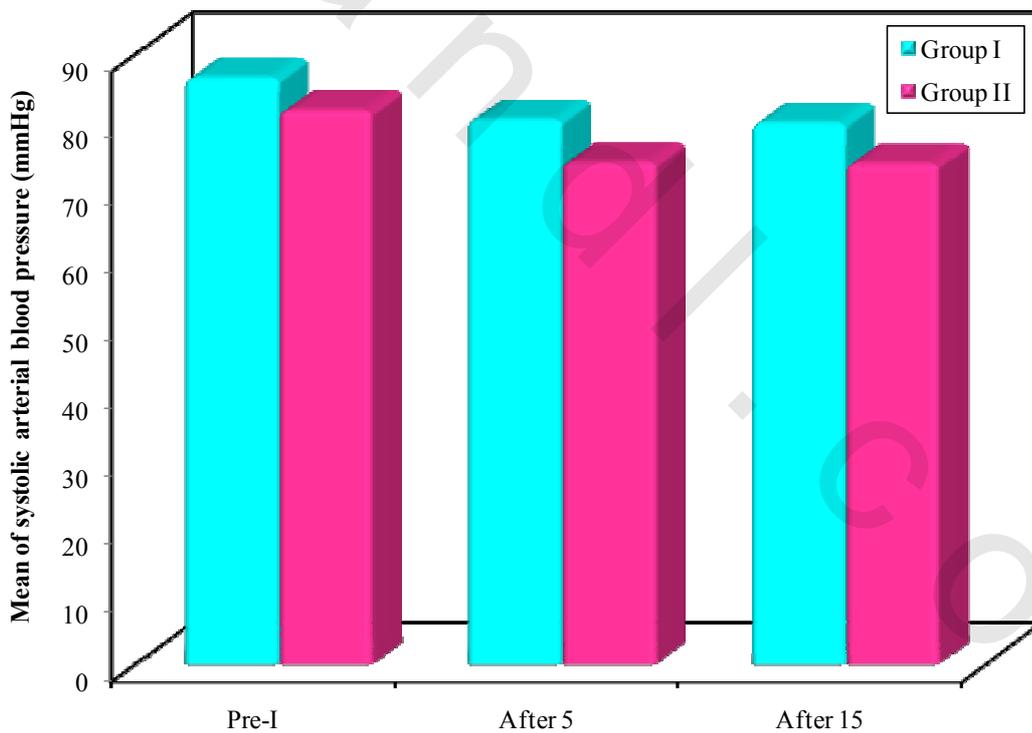P value significant if ≤0.05

Figure (8): Systolic arterial blood pressure changes in the two studied groups (mmHg).

Diastolic arterial blood pressure changes: (mmHg) (tables 13, 14, 15, figure 9)

In group I, At preinduction, it was 51.89 ± 9.79.   5 minutes after induction (as baseline), it decreased significantly to a mean of 46.11 ± 9.31. 15 minutes after drug administration, it decreased insignificantly to a mean of 45.0 ± 8.26.

In group II, At preinduction, it was 49.44 ± 10.64. 5 minutes after induction (as baseline), it decreased significantly to a mean of 45.22 ± 10.74. 15 minutes after drug administration, it decreased insignificantly to a mean of 44.28 ± 11.55.

Comparison between the two groups revealed no statistically significant difference at preinduction, 5 minutes after induction and 15 minutes after drug administration (p=0.478,0.792,0.830 respectively).

Table (13): Diastolic arterial blood pressure changes in Group I (mmHg)

Case number	Pre-I	After 5	After 15
1	44	38	40
2	40	36	34
3	73	68	60
4	55	50	45
5	50	44	45
6	60	53	52
7	57	51	50
8	63	58	60
9	52	48	45
10	53	47	50
11	42	38	35
12	45	40	43
13	38	34	35
14	60	55	51
15	35	30	30
16	53	47	45
17	55	47	45
18	59	46	45
Min. – Max.	35.0 – 73.0	30.0 – 68.0	30.0 – 60.0
Mean ± SD.	51.89 ± 9.79	46.11 ± 9.31	45.0 ± 8.26
Median	53.0	47.0	45.0
p₁		$<0.001^{*}$	$<0.001^{*}$
p₂		0.370	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (14): Diastolic arterial blood pressure changes in Group II (mmHg)

Case number	Pre-I	After 5	After 15
1	45	40	38
2	71	68	67
3	42	39	38
4	50	48	46
5	36	30	25
6	36	35	31
7	70	67	65
8	40	38	34
9	53	49	46
10	50	44	45
11	63	59	60
12	40	36	35
13	45	40	42
14	56	49	50
15	55	50	52
16	50	45	46
17	38	33	32
18	50	44	45
Min. – Max.	36.0 – 71.0	30.0 – 68.0	25.0 – 64.0
Mean ± SD.	49.44 ± 10.64	45.22 ± 10.74	44.28 ± 11.55
Median	50.0	44.0	45.0
p₁		$<0.001^*$	$<0.001^*$
p₂		0.241	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (15): **Diastolic arterial blood pressure changes in the two studied groups (mmHg).**

	Pre-I	**After 5**	**After 15**
Group I			
Min. – Max.	35.0 – 73.0	30.0 – 68.0	30.0 – 60.0
Mean ± SD.	51.89 ± 9.79	46.11 ± 9.31	45.0 ± 8.26
Median	53.0	47.0	45.0
Group II			
Min. – Max.	36.0 – 71.0	30.0 – 68.0	25.0 – 64.0
Mean ± SD.	49.44 ± 10.64	45.22 ± 10.74	44.28 ± 11.55
Median	50.0	44.0	45.0
t	0.717	0.265	0.216
p	0.478	0.792	0.830

t: Student t-test
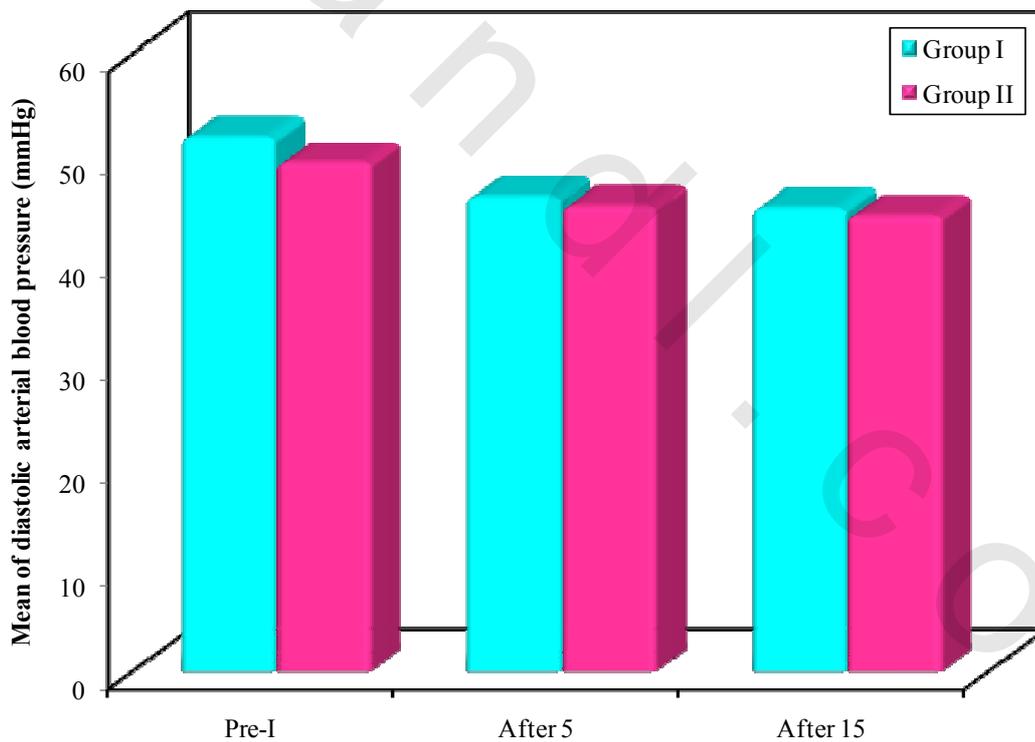P value significant if ≤0.05

Figure (9): Diastolic arterial blood pressure changes in the two studied groups (mmHg).

Mean arterial blood pressure changes: (mmHg) (tables 16, 17, 18, figure10)

In group I, At preinduction, it was 59.06 ± 11.74. 5 minutes after induction (as baseline), it decreased significantly to a mean of 54.17 ± 13.08. 15 minutes after drug administration, it decreased insignificantly to a mean of 52.94 ± 10.74.

In group II, At preinduction, it was 58.78 ± 9.96. 5 minutes after induction (as baseline), it decreased significantly to a mean of 52.44 ± 10.03. 15 minutes after drug administration, it decreased insignificantly to a mean of 53.50 ± 10.84.

Comparison between the two groups revealed no statistically significant difference at preinduction, 5 minutes after induction and 15 minutes after drug administration (p=0.939,0.660,0.878 respectively).

Table (16): Mean arterial blood pressure changes in Group I (mmHg)

Case number	Pre-I	After 5	After 15
1	43	33	38
2	45	41	40
3	85	83	75
4	54	49	48
5	64	60	59
6	66	63	62
7	70	67	62
8	67	63	60
9	52	48	46
10	65	60	61
11	50	45	44
12	60	56	55
13	50	47	49
14	68	61	60
15	38	29	32
16	60	53	52
17	71	67	62
18	55	50	48
Min. – Max.	38.0 – 85.0	29.0 – 83.0	32.0 – 75.0
Mean ± SD.	59.06 ± 11.74	54.17 ± 13.08	52.94 ± 10.74
Median	60.0	54.50	53.50
p_1		$<0.001^*$	$<0.001^*$
p_2		0.300	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (17): Mean arterial blood pressure changes in Group II (mmHg)

Case number	Pre-I	After 5	After 15
1	62	59	58
2	81	77	77
3	52	49	48
4	53	48	46
5	40	34	32
6	50	46	45
7	67	60	62
8	55	51	48
9	66	59	61
10	65	57	62
11	69	61	65
12	42	36	38
13	60	50	52
14	59	54	55
15	65	55	60
16	64	59	61
17	53	45	47
18	55	44	46
Min. – Max.	40.0 – 81.0	34.0 – 77.0	32.0 – 77.0
Mean ± SD.	58.78 ± 9.96	52.44 ± 10.03	53.50 ± 10.84
Median	59.50	52.50	53.50
p₁		<0.001[*]	<0.001[*]
p₂		0.226	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

[*]: Statistically significant at $p \leq 0.05$

Table (18): Mean arterial blood pressure changes in the two studied groups (mmHg).

	Pre-I	**After 5**	**After 15**
Group I			
Min. – Max.	38.0 – 85.0	29.0 – 83.0	32.0 – 75.0
Mean ± SD.	59.06 ± 11.74	54.17 ± 13.08	52.94 ± 10.74
Median	60.0	54.50	53.50
Group II			
Min. – Max.	40.0 – 81.0	34.0 – 77.0	32.0 – 77.0
Mean ± SD.	58.78 ± 9.96	52.44 ± 10.03	53.50 ± 10.84
Median	59.50	52.50	53.50
t	0.077	0.443	0.154
p	0.939	0.660	0.878

t: Student t-test
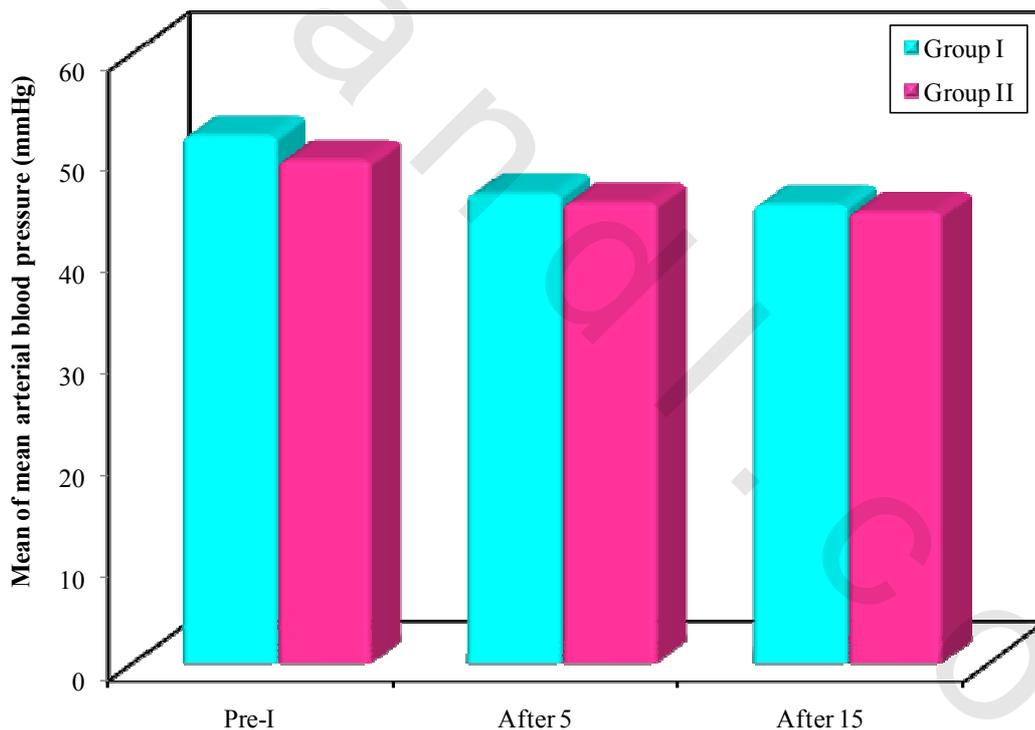P value significant if ≤0.05

Figure (10): Mean arterial blood pressure changes in the two studied groups (mmHg).

Systolic pulmonary blood pressure changes: (mmHg) (tables 19, 20, 21, figure11)

In group I, At 5 minutes after induction (as baseline), it was 71.39 ± 20.31. 15 minutes after drug administration, it decreased significantly to a mean of 60.78 ± 20.13.

In group II, At 5 minutes after induction (as baseline), it was 61.94 ± 17.69. 15 minutes after drug administration, it decreased significantly to a mean of 54.39 ± 16.52.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.146, 0.305 respectively).

Table (19): Systolic pulmonary arterial blood pressure changes in Group I (mmHg).

Case number	After 5	After 15
1	45	40
2	58	50
3	107	100
4	55	45
5	70	60
6	77	58
7	88	80
8	64	55
9	54	45
10	75	65
11	55	40
12	101	85
13	53	40
14	96	85
15	54	46
16	50	40
17	103	95
18	80	65
Min. – Max.	45.0 – 107.0	40.0 – 100.0
Mean ± SD.	71.39 ± 20.31	60.78 ± 20.13
Median	67.0	56.50
t	12.450[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (20): Systolic pulmonary arterial blood pressure changes in Group II (mmHg).

Case number	After 5	After 15
1	42	38
2	57	50
3	64	58
4	113	99
5	45	40
6	66	60
7	45	40
8	82	78
9	69	60
10	70	60
11	62	55
12	52	48
13	68	58
14	48	38
15	55	45
16	80	73
17	56	46
18	41	33
Min. – Max.	41.0 – 113.0	33.0 – 99.0
Mean ± SD.	61.94 ± 17.69	54.39 ± 16.52
Median	59.50	52.50
t	11.572[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (21): **Systolic pulmonary arterial blood pressure changes in the two studied groups (mmHg).**

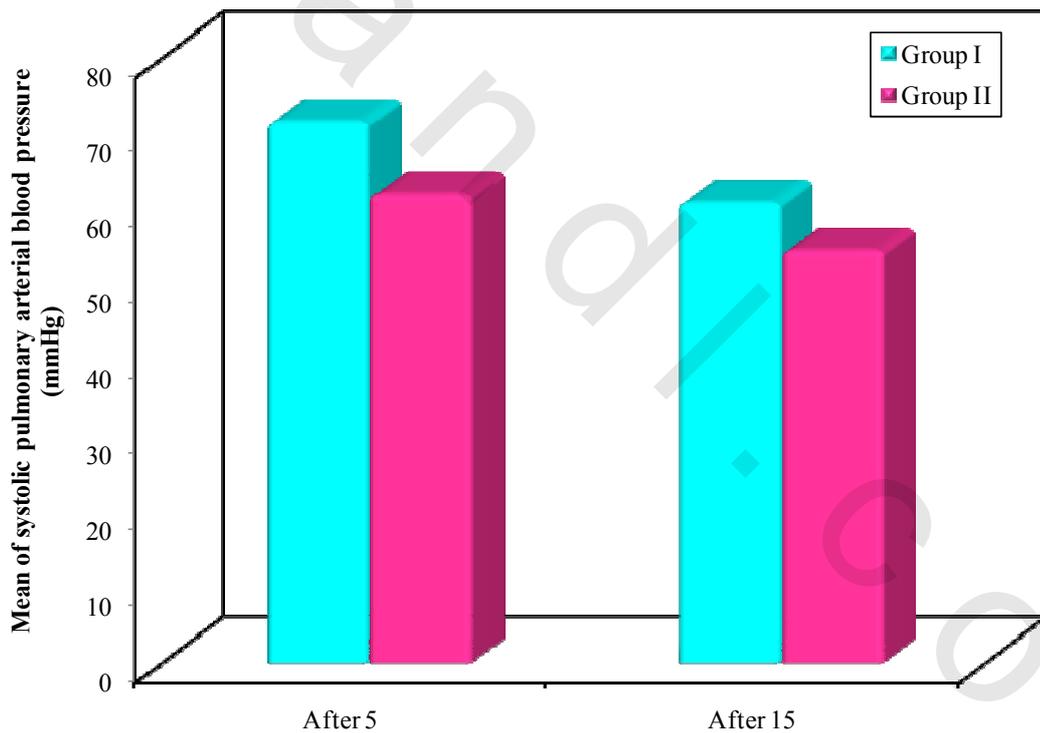|	Group I (n=18)	Group II (n=18)	t	p
After 5 Min. – Max. Mean ± SD. Median	45.0 – 107.0 71.39 ± 20.31 67.0	41.0 – 113.0 61.94 ± 17.69 59.50	1.488	0.146
After 15 Min. – Max. Mean ± SD. Median	40.0 – 100.0 60.78 ± 20.13 56.50	33.0 – 99.0 54.39 ± 16.52 52.50	1.041	0.305

t: Student t-test
P value significant if ≤0.05

Figure (11): Systolic pulmonary arterial blood pressure changes in the two studied groups (mmHg).

Diastolic pulmonary blood pressure changes: (mmHg) (tables 22, 23, 24, figure 12)

In group I, At 5 minutes after induction (as baseline), it was 37.83 ± 19.59. 15 minutes after drug administration, it decreased significantly to a mean of 28.11 ± 14.31.

In group II, At 5 minutes after induction (as baseline), it was 32.72 ± 15.53. 15 minutes after drug administration, it decreased significantly to a mean of 27.06 ± 14.52.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.392, 0.827 respectively).

Table (22): Diastolic pulmonary arterial blood pressure changes in Group I (mmHg).

Case number	After 5	After 15
1	20	18
2	48	40
3	70	55
4	28	20
5	23	18
6	41	40
7	50	40
8	44	35
9	12	10
10	32	20
11	23	18
12	76	50
13	14	12
14	58	40
15	21	13
16	16	12
17	55	40
18	50	25
Min. – Max.	12.0 – 76.0	10.0 – 55.0
Mean ± SD.	37.83 ± 19.59	28.11 ± 14.31
Median	36.50	22.50
t	5.462[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (23): Diastolic pulmonary arterial blood pressure changes in Group II (mmHg).

Case number	After 5	After 15
1	20	16
2	31	25
3	26	23
4	72	68
5	14	12
6	29	25
7	18	15
8	44	40
9	52	50
10	23	18
11	55	40
12	21	18
13	39	28
14	18	12
15	28	20
16	46	33
17	25	22
18	28	22
Min. – Max.	14.0 – 72.0	12.0 – 68.0
Mean ± SD.	32.72 ± 15.53	27.06 ± 14.52
Median	28.0	22.50
t	6.372[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (24): **Diastolic pulmonary arterial blood pressure changes in the two studied groups (mmHg).**

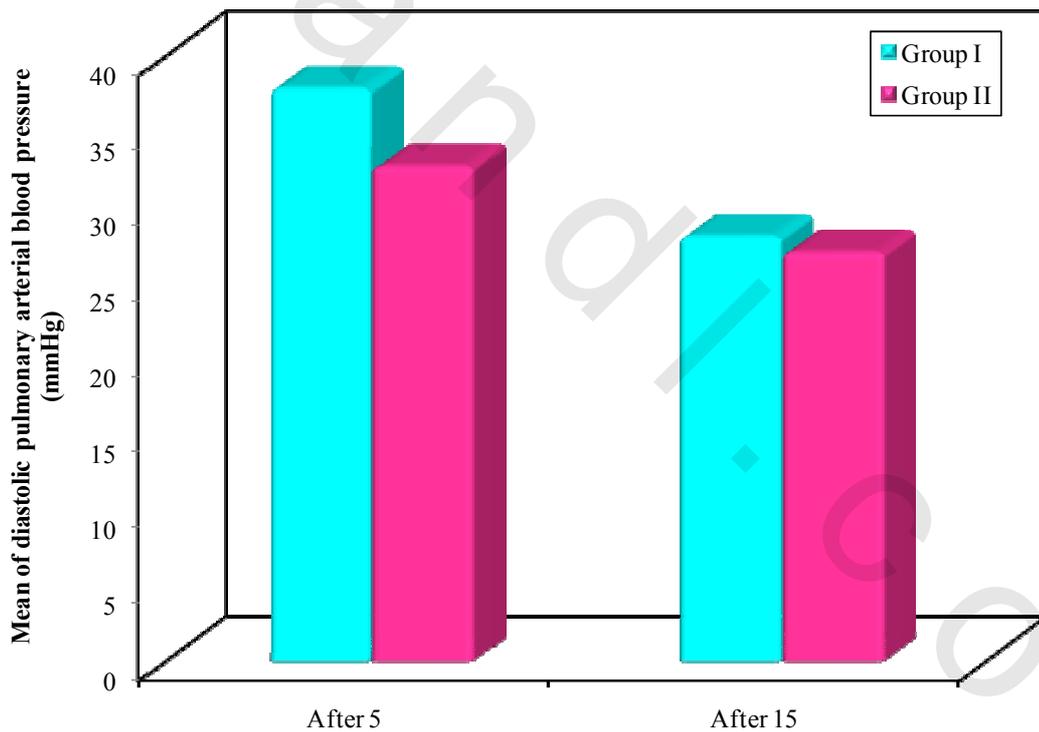|	**Group I (n=18)**	**Group II (n=18)**	**t**	**p**
After 5 Min. – Max. Mean ± SD. Median	12.0 – 76.0 37.83 ± 19.59 36.50	14.0 – 72.0 32.72 ± 15.53 28.0	0.868	0.392
After 15 Min. – Max. Mean ± SD. Median	10.0 – 55.0 28.11 ± 14.31 22.50	12.0 – 68.0 27.06 ± 14.52 22.50	0.220	0.827

t: Student t-test
P value significant if ≤0.05

Figure (12): Diastolic pulmonary arterial blood pressure changes in the two studied groups (mmHg).

Mean pulmonary blood pressure changes: (mmHg) (tables 25, 26, 27, figure 13)

In group I, At 5 minutes after induction (as baseline), it was 49.0 ± 19.09. 15 minutes after drug administration, it decreased significantly to a mean of 38.06 ± 14.63.

In group II, At 5 minutes after induction (as baseline), it was 42.83 ± 15.51. 15 minutes after drug administration, it decreased significantly to a mean of 35.78 ± 14.90.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.295, 0.646 respectively).

Table (25): Mean pulmonary arterial blood pressure changes in Group I (mmHg).

Case number	After 5	After 15
1	30	25
2	53	43
3	82	68
4	37	30
5	38	30
6	53	46
7	62	50
8	50	42
9	26	21
10	46	35
11	33	25
12	84	60
13	28	21
14	70	50
15	32	24
16	27	21
17	71	56
18	60	38
Min. – Max.	26.0 – 84.0	21.0 – 68.0
Mean ± SD.	49.0 ± 19.09	38.06 ± 14.63
Median	48.0	36.50
t	7.957[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (26): Mean pulmonary arterial blood pressure changes in Group II (mmHg).

Case number	After 5	After 15
1	28	24
2	40	33
3	38	34
4	85	79
5	25	20
6	41	37
7	27	23
8	56	52
9	60	53
10	38	32
11	57	45
12	33	25
13	48	38
14	28	20
15	37	28
16	60	46
17	35	30
18	35	25
Min. – Max.	25.0 – 85.0	20.0 – 79.0
Mean ± SD.	42.83 ± 15.51	35.78 ± 14.90
Median	38.0	32.50
t	9.980[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (27): **Mean pulmonary arterial blood pressure changes in the two studied groups (mmHg).**

	Group I (n=18)	Group II (n=18)	t	p
After 5				
Min. – Max.	26.0 – 84.0	25.0 – 85.0		
Mean ± SD.	49.0 ± 19.09	42.83 ± 15.51	1.064	0.295
Median	48.0	38.0		
After 15				
Min. – Max.	21.0 – 68.0	20.0 – 79.0		
Mean ± SD.	38.06 ± 14.63	35.78 ± 14.90	0.463	0.646
Median	36.50	32.50		

t: Student t-test
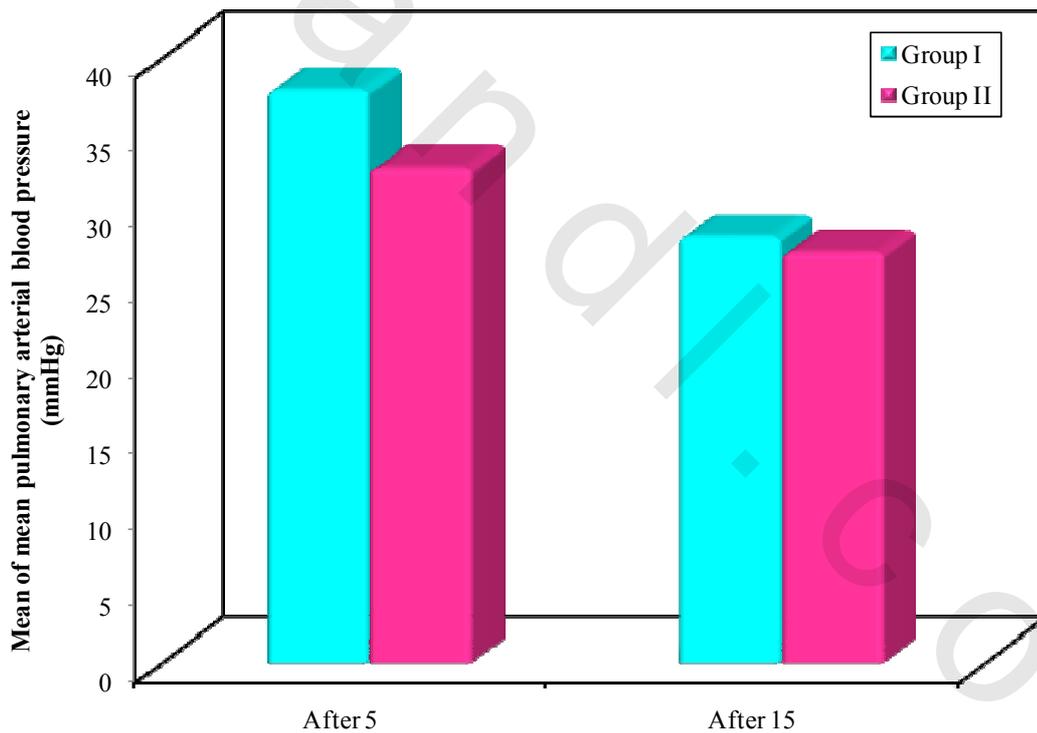P value significant if ≤0.05

Figure (13): Mean pulmonary arterial blood pressure changes in the two studied groups (mmHg).

Superior vena cava oxygen saturation Changes: (%) (tables 28, 29, 30, figure 14)

In group I, At 5 minutes after induction (as baseline), it was 84.49 ± 7.35. 15 minutes after drug administration, it increased significantly to a mean of 92.36 ± 4.52.

In group II, At 5 minutes after induction (as baseline), it was 85.89 ± 4.23. 15 minutes after drug administration, it increased significantly to a mean of 92.94 ± 1.83.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.427, 0.617 respectively).

Table (28): Superior vena cava oxygen saturation changes in Group I (%).

Case number	After 5	After 15
1	96	98
2	75	88
3	86	90.5
4	80	85
5	90	94
6	95	97
7	88	92
8	85	92
9	87.9	90
10	88	93
11	67	80
12	86	92
13	88	93
14	93	95.5
15	92	95
16	91	95
17	92	95.5
18	95	97
Min. – Max.	67.0 – 96.0	80.0 – 98.0
Mean ± SD.	84.49 ± 7.35	92.36 ± 4.52
Median	88.0	93.0
t	6.279[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (29): Superior vena cava oxygen saturation changes in Group II (%).

Case number	After 5	After 15
1	96	97
2	83	90
3	79	90
4	90	92
5	88	93
6	85	92
7	89	92
8	87	94
9	82	92
10	90	94
11	88	94
12	88	94
13	85	94
14	85	95
15	80	90
16	85	93
17	80	93
18	86	94
Min. – Max.	79.0 – 96.0	90.0 – 97.0
Mean ± SD.	85.89 ± 4.23	92.94 ± 1.83
Median	85.50	93.0
t	9.278[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (30): **Superior vena cava oxygen saturation changes in the two studied groups (%).**

	Group I (n=18)	Group II (n=18)	t	p
After 5 Min. – Max. Mean ± SD. Median	67.0 – 96.0 84.49 ± 7.35 88.0	79.0 – 96.0 85.89 ± 4.23 85.50	0.803	0.427
After 15 Min. – Max. Mean ± SD. Median	80.0 – 98.0 92.36 ± 4.52 93.0	90.0 – 97.0 92.94± 1.83 93.0	0.507	0.617

t: Student t-test
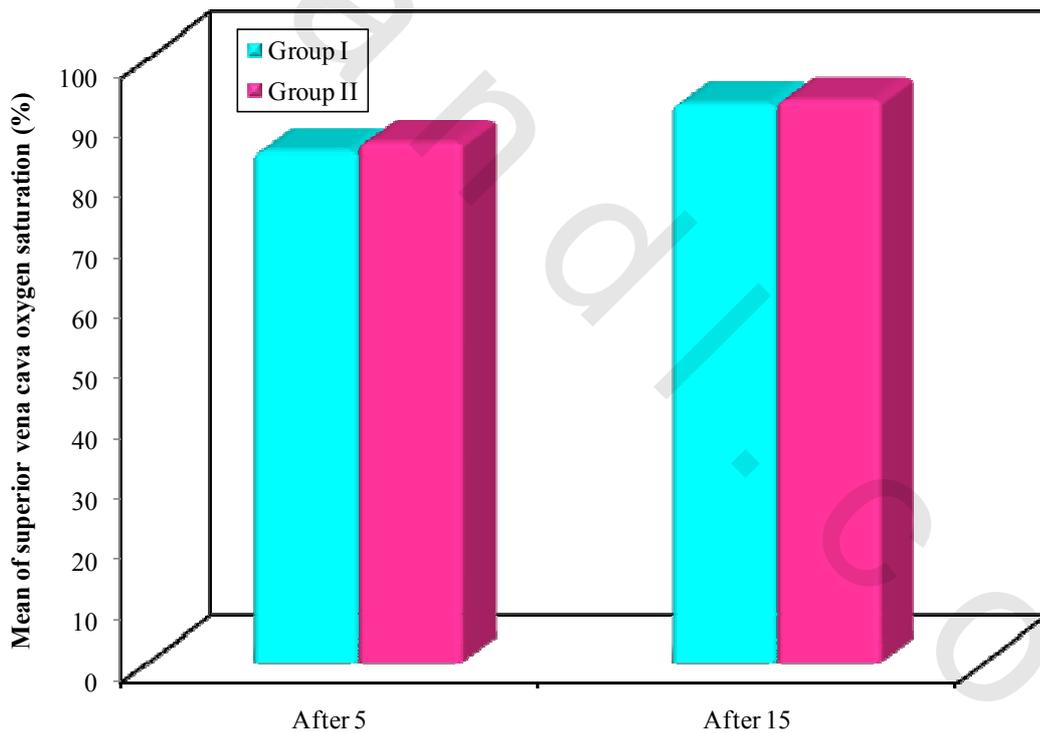P value significant if ≤0.05

Figure (14): Superior vena cava oxygen saturation changes in the two studied groups (%).

Pulmonary artery oxygen saturation changes: (%) (tables 31, 32, 33, figure 15)

In group I, At 5 minutes after induction (as baseline), it was 92.97 ± 2.46. 15 minutes after drug administration, it increased significantly to a mean of 96.52 ± 1.37.

In group II, At 5 minutes after induction (as baseline), it was 92.84 ± 3.54. 15 minutes after drug administration, it increased significantly to a mean of 97.14 ± 1.14.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.901, 0.150 respectively).

Table (31): Pulmonary artery oxygen saturation changes in Group I (%)

Case number	After 5	After 15
1	96	98.9
2	88	95
3	90	94
4	96	98
5	95	97
6	95	98
7	93	96
8	92	96
9	93	96
10	94	97
11	90	95
12	91	95
13	94	97
14	91	96
15	92	96
16	95	98
17	91.5	96
18	97	98.5
Min. – Max.	88.0 – 97.0	94.0 – 98.90
Mean ± SD.	92.97 ± 2.46	96.52 ± 1.37
Median	93.0	96.0
t	11.519*	
p	<0.001*	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (32): Pulmonary artery oxygen saturation changes in Group II (%)

Case number	After 5	After 15
1	97	98.5
2	86	95
3	85.7	96
4	88	95
5	92	96
6	92	97
7	94	97
8	93.5	97
9	97	99
10	95	97
11	96	98
12	94	97.5
13	96	98.5
14	94	98
15	96	98
16	92	97
17	89	96.5
18	94	97.5
Min. – Max.	85.70 – 97.0	95.0 – 99.0
Mean ± SD.	92.84 ± 3.54	97.14 ± 1.14
Median	94.0	97.0
t	7.079[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (33): **Pulmonary artery oxygen saturation changes in the two studied groups (%).**

	Group I (n=18)	Group II (n=18)	t	p
After 5				
Min. – Max.	88.0 – 97.0	85.70 – 97.0		
Mean ± SD.	92.97 ± 2.46	92.84 ± 3.54	0.126	0.901
Median	93.0	94.0		
After 15				
Min. – Max.	94.0 – 98.90	95.0 – 99.0		
Mean ± SD.	96.52 ± 1.37	97.14 ± 1.14	1.473	0.150
Median	96.0	97.0		

t: Student t-test
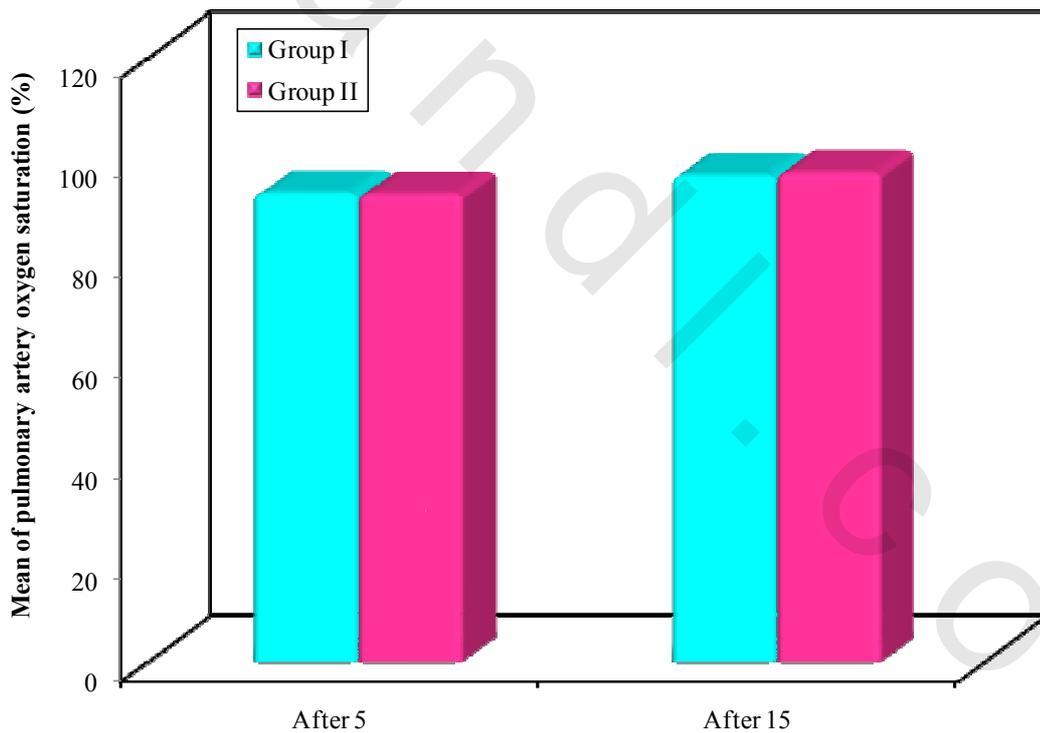P value significant if ≤0.05

Figure (15): Pulmonary artery oxygen saturation changes in the two studied groups (%).

Femoral artery oxygen saturation changes: (%) (tables 34, 35, 36, figure 16)

In group I, At preinduction, it was 97.06 ± 0.87. 5 minutes after induction (as baseline), it increased significantly to a mean of 98.80 ± 0.52. 15 minutes after drug administration, it increased insignificantly to a mean of 99.06 ± 0.16.

In group II, At preinduction, it was 96.94 ± 1.92. 5 minutes after induction (as baseline), it increased significantly to a mean of 98.53 ± 1.92. 15 minutes after drug administration, it increased insignificantly to a mean of 99.03 ± 0.58.

Comparison between the two groups revealed no statistically significant difference at preinduction, 5 minutes after induction and 15 minutes after drug administration (p=0.825,0.568,0.847 respectively).

Table (34): Femoral artery oxygen saturation changes in Group I (%).

Case number	Pre-I	After 5	After 15
1	97	99	99
2	95	97	99.5
3	96	98	99.5
4	98	99	99
5	97	99	99
6	97	98.9	99
7	98	99	99
8	97	99	99
9	98	99	99
10	98	99	99
11	97	99	99
12	97	99	99
13	96	98.5	99
14	97	99	99
15	98	99	99
16	96	99	99
17	97	99	99
18	98	99	99
Min. – Max.	95.0 – 98.0	97.0 – 99.0	99.0 – 99.50
Mean ± SD.	97.06 ± 0.87	98.80 ± 0.52	99.06 ± 0.16
Median	97.0	99.0	99.0
p₁		<0.001[*]	<0.001[*]
p₂		0.369	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (35): Femoral artery oxygen saturation changes in Group II (%).

Case number	Pre-I	After 5	After 15
1	97	99	99
2	93	95	99
3	91	92	97
4	97	99	99
5	98	99	99
6	97	99	99
7	98	99	99
8	98	99	99
9	97	99.5	99.5
10	97	99	99
11	97	99	99
12	99	99.7	99.7
13	98	100	100
14	98	99	99
15	98	99	99
16	97	99	99
17	98	99	99
18	97	99.3	99.3
Min. – Max.	91.0 – 99.0	92.0 – 100.0	97.0 – 100.0
Mean ± SD.	96.94 ± 1.92	98.53 ± 1.92	99.03 ± 0.58
Median	97.0	99.0	99.0
p₁		$<0.001^{*}$	$<0.001^{*}$
p₂		0.498	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (36): Femoral artery oxygen saturation changes in the two studied groups (%).

	Pre-I	After 5	After 15
Group I Min. – Max.	95.0 – 98.0	97.0 – 99.0	99.0 – 99.50
Mean ± SD.	97.06 ± 0.87	98.80 ± 0.52	99.06 ± 0.16
Median	97.0	99.0	99.0
Group II Min. – Max.	91.0 – 99.0	92.0 – 100.0	97.0 – 100.0
Mean ± SD.	96.94 ± 1.92	98.53 ± 1.92	99.03 ± 0.58
Median	97.0	99.0	99.0
t	0.223	0.580	0.194
p	0.825	0.568	0.847

t: Student t-test
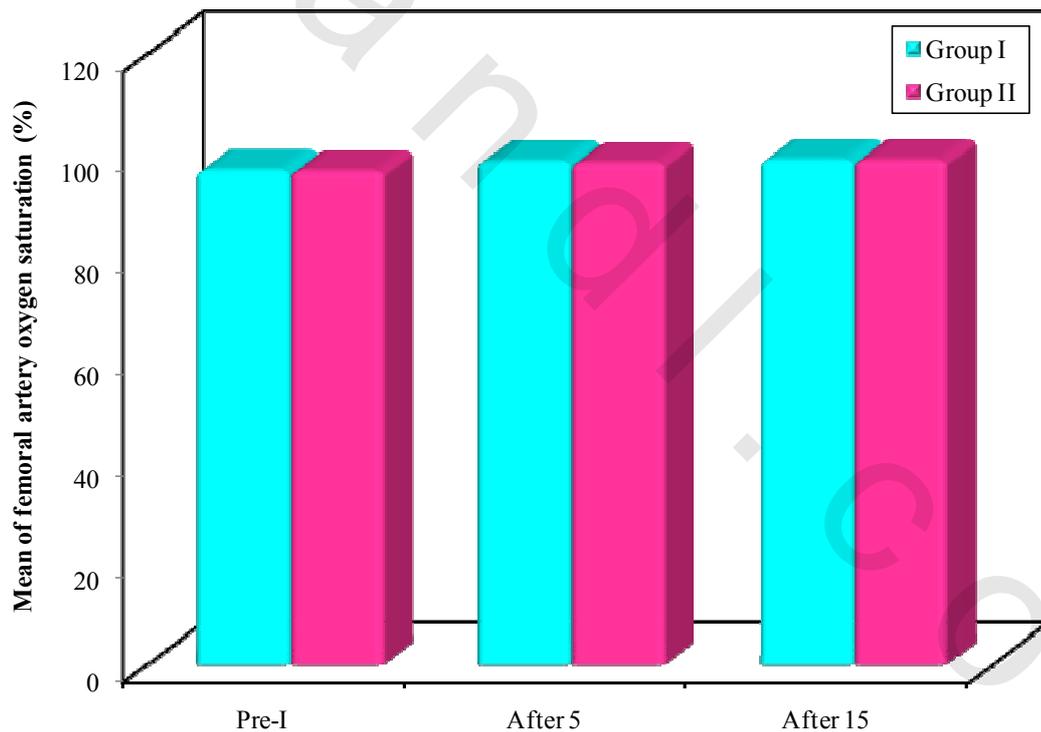P value significant if ≤0.05

Figure (16): Femoral artery oxygen saturation changes in the two studied groups (%).

Superior vena cava partial pressure of oxygen Changes: (mmHg) (tables 37, 38, 39, figure 17)

In group I, At 5 minutes after induction (as baseline), it was 60.11 ± 14.05. 15 minutes after drug administration, it increased significantly to a mean of 74.56 ± 15.82.

In group II, At 5 minutes after induction (as baseline), it was 55.51 ± 8.85. 15 minutes after drug administration, it increased significantly to a mean of 74.56 ± 9.45.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.248, 1.000 respectively).

Table (37): **Superior vena cava partial pressure of oxygen changes in Group I (mmHg).**

Case number	After 5	After 15
1	85	99.5
2	35	54
3	54	62
4	45	55
5	60	83
6	83	98
7	58	62.5
8	53	67
9	56	62
10	58	71
11	37	50
12	54	67
13	58	72
14	68	83.5
15	66	85.5
16	63	86
17	66	86
18	83	98
Min. – Max.	35.0 – 85.0	50.0 – 99.50
Mean ± SD.	60.11 ± 14.05	74.56 ± 15.82
Median	58.0	71.50
t	11.737[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (38): Superior vena cava partial pressure of oxygen changes in Group II (mmHg).

Case number	After 5	After 15
1	85	98
2	50	60.5
3	48	68
4	60	68
5	58	68.9
6	53	78
7	60	68
8	56.5	80.1
9	48	68
10	60	80.3
11	58	80.5
12	58.5	80.8
13	53	80.9
14	53.5	83.5
15	45	61
16	53.2	68.6
17	45.5	68.2
18	54	80.7
Min. – Max.	45.0 – 85.0	60.50 – 98.0
Mean ± SD.	55.51 ± 8.85	74.56 ± 9.45
Median	53.75	73.45
t	11.816[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (39): Superior vena cava partial pressure of oxygen changes in the two studied groups (mmHg).

	Group I (n=18)	Group II (n=18)	t	p
After 5				
Min. – Max.	35.0 – 85.0	45.0 – 85.0		
Mean ± SD.	60.11 ± 14.05	55.51 ± 8.85	1.175	0.248
Median	58.0	53.75		
After 15				
Min. – Max.	50.0 – 99.50	60.50 – 98.0		
Mean ± SD.	74.56 ± 15.82	74.56 ± 9.45	0.01	1.000
Median	71.50	73.45		

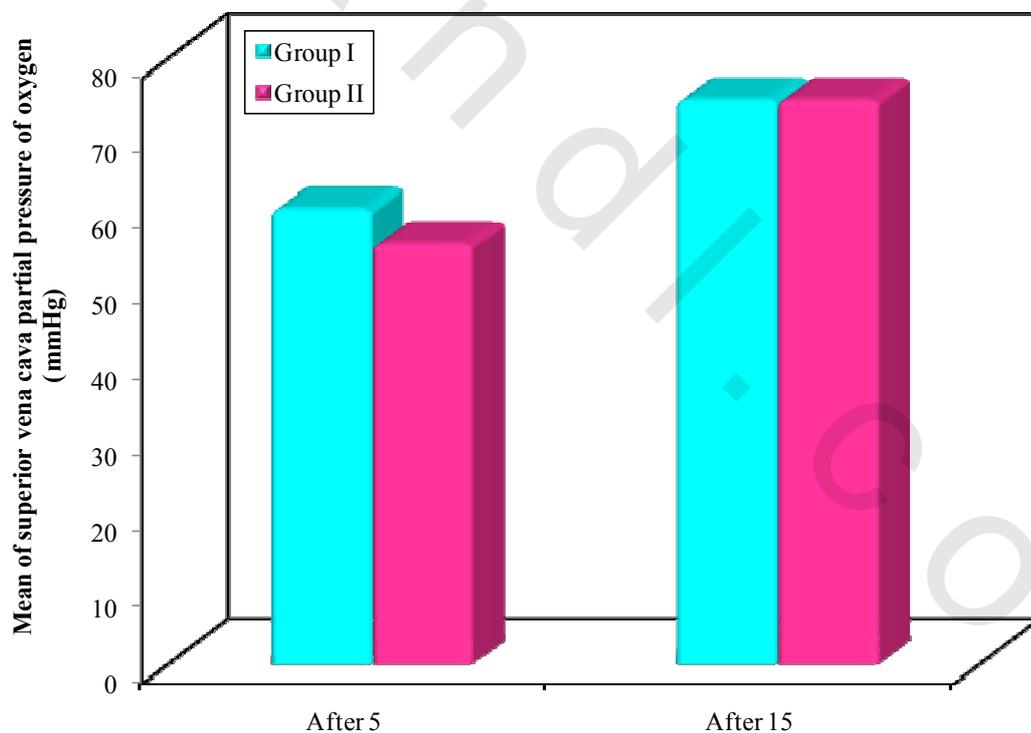t: Student t-test
P value significant if ≤0.05

Figure (17): Superior vena cava partial pressure of oxygen changes in the two studied groups (mmHg).

Pulmonary artery partial pressure of oxygen Changes: (mmHg) (tables 40, 41, 42, figure 18)

In group I, At 5 minutes after induction (as baseline), it was 73.28 ± 11.62. 15 minutes after drug administration, it increased significantly to a mean of 91.39 ± 7.16.

In group II, At 5 minutes after induction (as baseline), it was 75.02 ± 13.73. 15 minutes after drug administration, it increased significantly to a mean of 94.77 ± 6.47.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.684, 0.147 respectively).

Table (40): Pulmonary artery partial pressure of oxygen changes in Group I (mmHg).

Case number	After 5	After 15
1	85.5	99.8
2	58.5	84.5
3	60.5	82
4	85.4	99.5
5	83.5	98
6	83.2	99.5
7	68.5	88
8	66.1	85.6
9	68.2	85.5
10	80.5	98.1
11	60.5	83.8
12	63.5	84
13	80.3	98.2
14	63.2	87
15	66.2	85.5
16	83.3	99.5
17	64	87
18	98.1	99.6
Min. – Max.	58.50 – 98.10	82.0 – 99.80
Mean ± SD.	73.28 ± 11.62	91.39 ± 7.16
Median	68.35	87.50
t	14.239[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (41): Pulmonary artery partial pressure of oxygen changes in Group II (mmHg).

Case number	After 5	After 15
1	98	99
2	54	83.5
3	53.5	85
4	58	83
5	66	85.2
6	66.5	97.5
7	80	98
8	70	98.3
9	98	98.5
10	83	98.4
11	85	99.5
12	80.5	99
13	85.5	99
14	80.1	99
15	85.2	99
16	66.2	98
17	60.5	87
18	80.3	99
Min. – Max.	53.50 – 98.0	83.0 – 99.50
Mean ± SD.	75.02 ± 13.73	94.77 ± 6.47
Median	80.05	98.35
t	8.920[*]	
p	<0.001[*]	

t: paired t-test
*: Statistically significant at $p \leq 0.05$

Table (42): **Pulmonary artery partial pressure of oxygen changes in the two studied groups (mmHg).**

	Group I (n=18)	Group II (n=18)	t	p
After 5				
Min. – Max.	58.50 – 98.10	53.50 – 98.0		
Mean ± SD.	73.28 ± 11.62	75.02 ± 13.73	0.410	0.684
Median	68.35	80.05		
After 15				
Min. – Max.	82.0 – 99.80	83.0 – 99.50		
Mean ± SD.	91.39 ± 7.16	94.77 ± 6.47	1.486	0.147
Median	87.50	98.35		

t: Student t-test
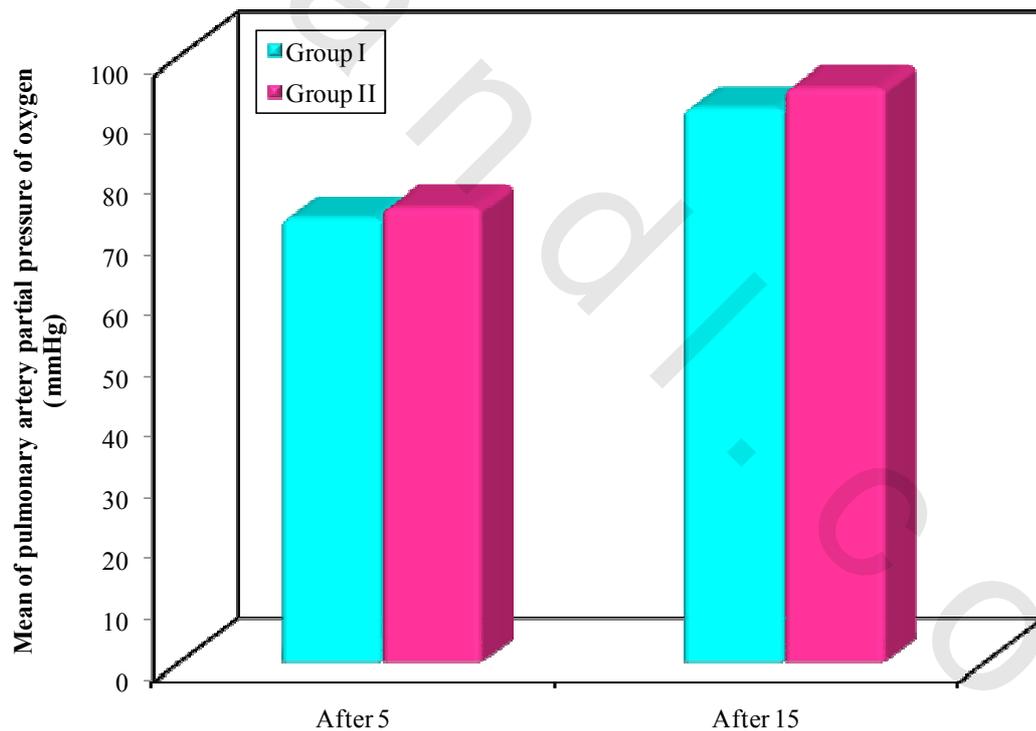P value significant if ≤0.05

Figure (18): Pulmonary artery partial pressure of oxygen changes in the two studied groups (mmHg).

Femoral artery partial pressure of oxygen changes: (mmHg) (tables 43, 44, 45, figure 19)

In group I, At preinduction, it was 127.11 ± 17.93. 5 minutes after induction (as baseline), it increased significantly to a mean of 366.94 ± 30.0. 15 minutes after drug administration, it increased significantly to a mean of 379.97 ± 24.24.

In group II, At preinduction, it was 131.39 ± 17.82. 5 minutes after induction (as baseline), it increased significantly to a mean of 381.0 ± 24.01. 15 minutes after drug administration, it increased significantly to a mean of 387.31 ± 19.01.

Comparison between the two groups revealed no statistically significant difference at preinduction value, 5 minutes after induction and 15 minutes after drug administration (p=0.478,0.130,0.320 respectively).

Table (43): Femoral artery partial pressure of oxygen changes in Group I (mmHg).

Case number	Pre- I	After 5	After 15
1	120	374	375
2	100	360	376
3	130	370	377
4	112	350	371
5	110	345	362
6	117	348	372
7	120	335	353
8	135	330	355
9	144	337	355.5
10	155	340	364
11	125	328	349
12	115	375	379
13	120	377	380
14	110	400	406
15	130	401	405
16	125	405	410
17	150	410	420
18	170	420	430
Min. – Max. **Mean ± SD.** **Median**	100.0 – 170.0 127.11 ± 17.93 122.50	328.0 – 420.0 366.94 ± 30.0 365.0	349.0 – 340.0 379.97 ± 24.24 375.5
p₁		<0.001*	<0.001*
p₂		<0.001*	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (44): Femoral artery partial pressure of oxygen changes in Group II (mmHg).

Case number	Pre-I	After 5	After 15
1	130	375	377
2	112	346	376
3	100	332	370
4	120	372	375
5	115	374	377
6	125	375	378
7	130	377	379
8	140	378	380
9	150	400	402
10	145	376	381
11	155	377	380
12	160	401	405
13	120	450	451.5
14	130	379	380
15	158	380	382
16	145	381	385
17	120	385	388
18	110	400	405
Min. – Max.	100.0 – 160.0	332.0 – 450.0	370.0 – 451.50
Mean ± SD.	131.39 ± 17.82	381.0 ± 24.01	387.31 ± 19.01
Median	130.0	377.50	380.0
p₁		<0.001*	<0.001*
p₂		0.054	

p_1: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between before with each other period

p_2: Stands for adjusted Bonferroni p-value for ANOVA with repeated measures for comparison between after 5 and 15

*: Statistically significant at $p \leq 0.05$

Table (45): Femoral artery partial pressure of oxygen changes in the two studied groups (mmHg).

	Pre-I	After 5	After 15
Group I			
Min. – Max.	100.0 – 170.0	328.0 – 420.0	349.0 – 340.0
Mean ± SD.	127.11 ± 17.93	366.94 ± 30.0	379.97 ± 24.24
Median	122.50	365.0	375.5
Group II			
Min. – Max.	100.0 – 160.0	332.0 – 450.0	370.0 – 451.50
Mean ± SD.	131.39 ± 17.82	381.0 ± 24.01	387.31 ± 19.01
Median	130.0	377.50	380.0
t	0.718	1.552	1.010
p	0.478	0.130	0.320

t: Student t-test
P value significant if ≤0.05

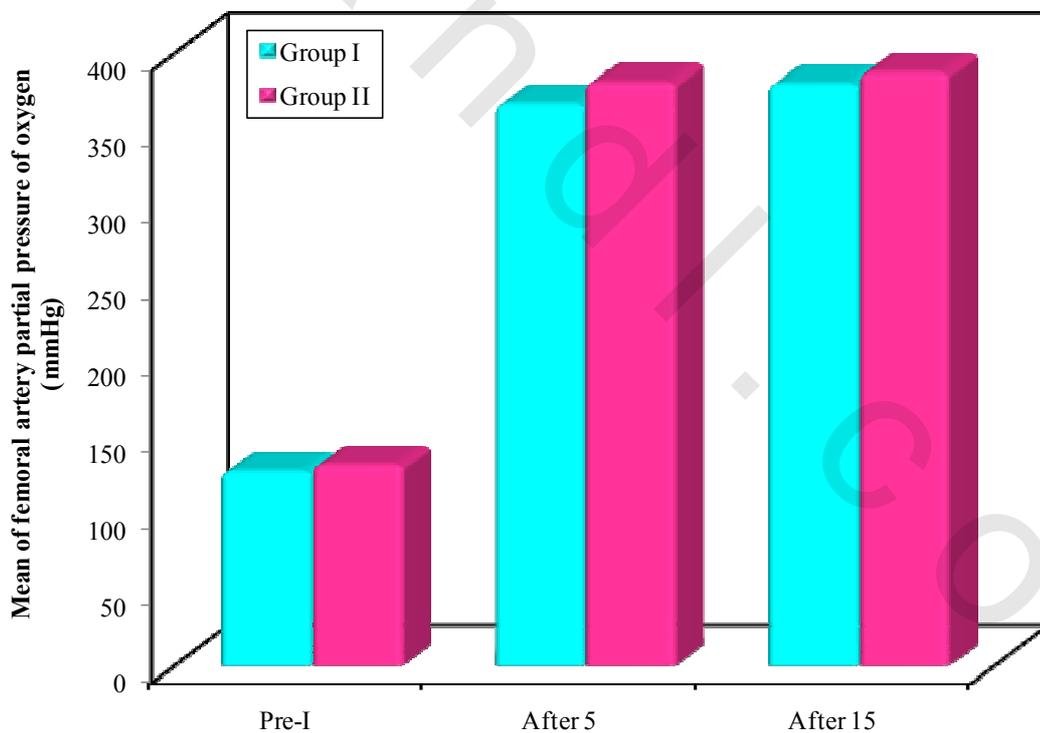**Figure (19):** Femoral artery partial pressure of oxygen changes in the two studied groups (mmHg).

Pulmonary vascular resistance index changes: $(dyn.s^1/cm^5/m^2)$ (tables 46, 47, 48, figure 20)

In group I, At 5 minutes after induction (as baseline), it was 1.34 ± 1.14. 15 minutes after drug administration, it decreased significantly to a mean of 0.49 ± 0.50.

In group II, At 5 minutes after induction (as baseline), it was 1.03 ± 1.17. 15 minutes after drug administration, it decreased significantly to a mean of 0.29 ± 0.40.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.429, 0.184 respectively).

Table (46): Pulmonary vascular resistance index changes in Group I (dyn.s^1/cm^5/m^2)

Case number	After 5	After 15
1	0.2561	0.0067
2	1.5011	0.5221
3	3.3817	1.8909
4	0.7358	0.818
5	0.3528	0.1309
6	1.2204	0.2653
7	2.2091	0.8635
8	0.892	0.3112
9	0.2724	0.1004
10	0.6032	0.1732
11	1.4284	0.4395
12	3.8853	1.3372
13	0.4786	0.1418
14	3.0529	0.7814
15	0.8068	0.2351
16	0.27	0.0472
17	2.0976	0.6424
18	0.672	0.0983
Min. – Max.	0.2561– 3.89	0.0067– 1.89
Mean ± SD.	1.34 ± 1.14	0.49 ± 0.50
Median	0.85	0.29
Z	3.680[*]	
p	<0.001[*]	

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

Table (47): Pulmonary vascular resistance index changes in Group II (dyn.s^1/cm^5/m^2)

Case number	After 5	After 15
1	0.1817	0.0368
2	1.8975	0.6644
3	0.787	0.1088
4	5.3503	1.7959
5	0.4858	0.1504
6	1.6865	0.4252
7	0.5723	0.1831
8	0.9041	0.3019
9	0.7007	0.1216
10	0.3688	0.1487
11	0.8897	0.2254
12	0.3657	0.0977
13	0.8632	0.2447
14	0.4695	0.0581
15	0.5886	0.1373
16	1.2738	0.2678
17	0.7155	0.1469
18	0.5023	0.1097
Min. – Max.	0.1817 – 5.35	0.0368 – 1.80
Mean ± SD.	1.03 ± 1.17	0.29 ± 0.40
Median	0.71	0.15
Z	3.724[*]	
p	<0.001[*]	

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

Table (48): Pulmonary vascular resistance index changes in the two studied groups $(dyn.s^1/cm^5/m^2)$

	Group I (n=18)	Group II (n=18)	Z	p
After 5				
Min. – Max.	0.2561– 3.89	0.1817 – 5.35		
Mean ± SD.	1.34 ± 1.14	1.03 ± 1.17	0.791	0.429
Median	0.85	0.71		
After 15				
Min. – Max.	0.0067– 1.89	0.0368 – 1.80		
Mean ± SD.	0.49 ± 0.50	0.29 ± 0.40	1.329	0.184
Median	0.29	0.15		

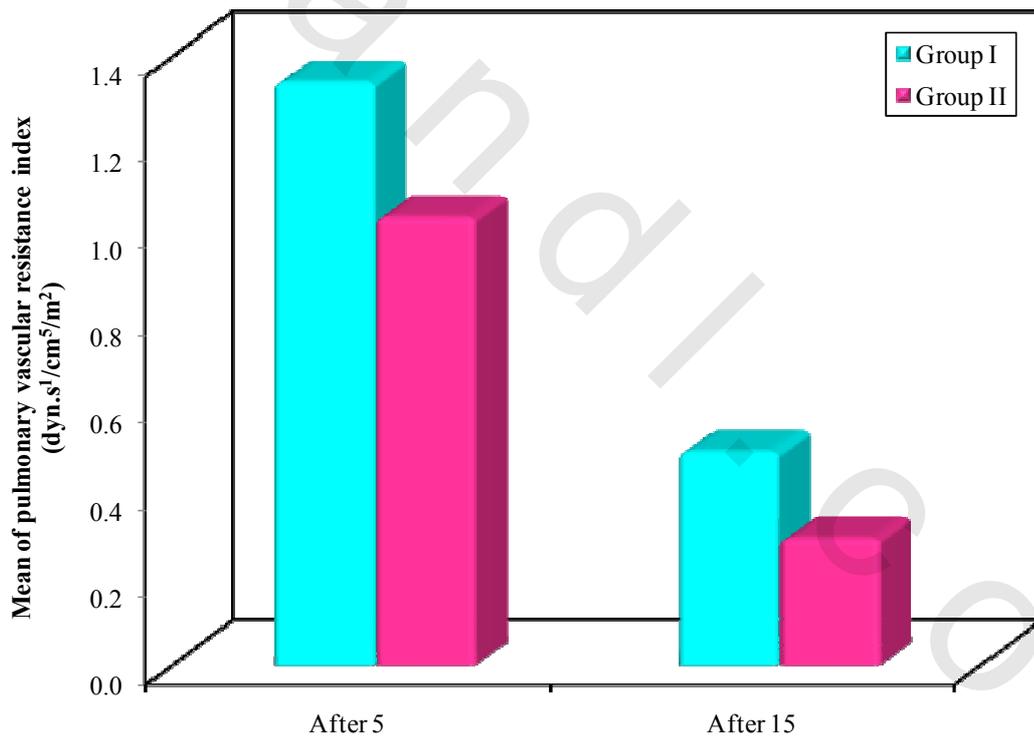Z: Z for Mann Whitney test
P value significant if ≤0.05

Figure (20): Pulmonary vascular resistance index changes in the two studied groups $(dyn.s^1/cm^5/m^2)$.

Systemic vascular resistance index changes: $(dyn.s^1/cm^5/m^2)$ (tables 49, 50, 51, figure 21)

In group I, At 5 minutes after induction (as baseline), it was 2.70 ± 2.21. 15 minutes after drug administration, it decreased significantly to a mean of 1.67 ± 1.50.

In group II, At 5 minutes after induction (as baseline), it was 2.66 ± 1.48. 15 minutes after drug administration, it decreased significantly to a mean of 1.43 ± 1.01.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.569,0.874 respectively).

Table (49): Systemic vascular resistance index changes in Group I (dyn.s^1/cm^5/m^2)

Case number	After 5	After 15
1	0.267	0.108
2	2.951	1.595
3	5.005	3.601
4	7.3	5.494
5	1.485	0.811
6	1.565	0.789
7	4.565	2.718
8	2.157	1.016
9	1.061	0.817
10	1.94	1.076
11	7.813	4.523
12	4.182	2.428
13	2.233	1.337
14	1.8953	1.272
15	0.71	0.461
16	1.35	0.661
17	0.994	0.795
18	1.09	0.52
Min. – Max.	0.27 – 7.81	0.11 – 5.49
Mean ± SD.	2.70 ± 2.21	1.67 ± 1.50
Median	1.92	1.05
Z	3.724[*]	
p	<0.001[*]	

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at p ≤ 0.05

Table (50): Systemic vascular resistance index changes in Group II (dyn.s^1/cm^5/m^2)

Case number	After 5	After 15
1	0.649	0.424
2	4.025	4.025
3	2.462	1.298
4	2.077	1.528
5	1.357	0.694
6	3.968	1.934
7	3.148	2.283
8	1.61	0.621
9	4.442	1.983
10	1.499	0.907
11	3.915	1.898
12	0.924	0.478
13	2.526	1.074
14	2.817	0.823
15	6.586	3.414
16	2.355	1.051
17	1.894	0.629
18	1.576	0.664
Min. – Max.	0.65 – 6.59	0.42 – 4.03
Mean ± SD.	2.66 ± 1.48	1.43 ± 1.01
Median	2.41	1.06
Z	3.621[*]	
p	<0.001[*]	

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

Table (51): Systemic vascular resistance index changes in the two studied groups (dyn.s^1/cm^5/m^2)

	Group I (n=18)	Group II (n=18)	Z	p
After 5				
Min. – Max.	0.27 – 7.81	0.65 – 6.59		
Mean ± SD.	2.70 ± 2.21	2.66 ± 1.48	0.569	0.569
Median	1.92	2.41		
After 15				
Min. – Max.	0.11 – 5.49	0.42 – 4.03		
Mean ± SD.	1.67 ± 1.50	1.43 ± 1.01	0.158	0.874
Median	1.05	1.06		

Z: Z for Mann Whitney test
P value significant if ≤0.05
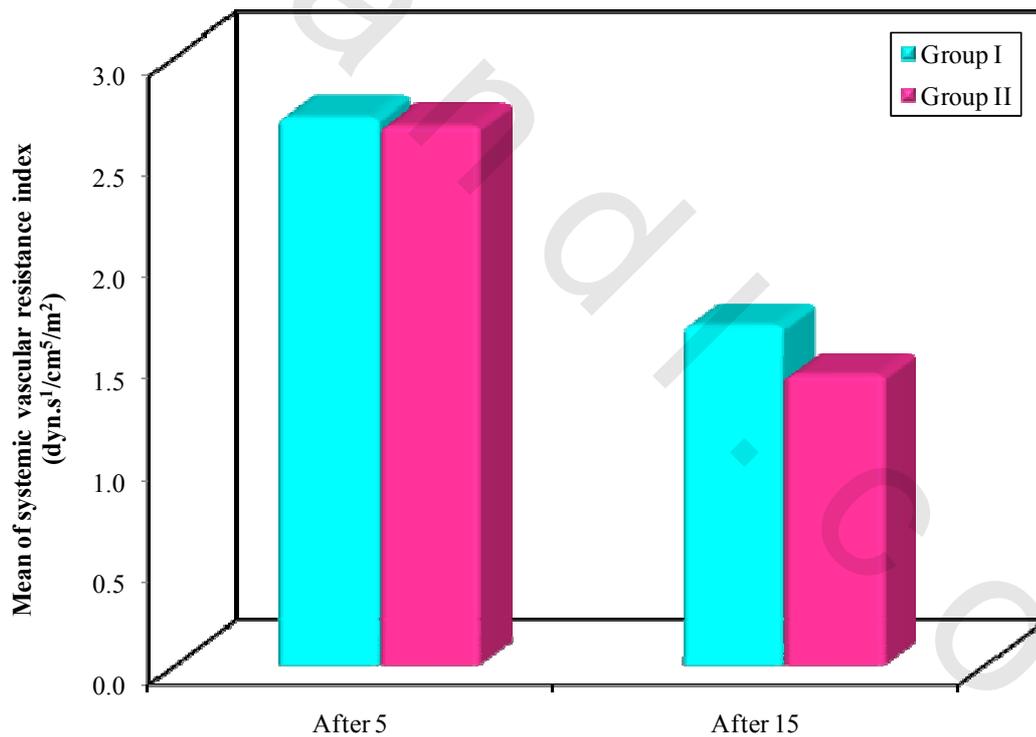

Figure (21): Systemic vascular resistance index changes in the two studied groups (dyn.s^1/cm^5/m^2).

Pulmonary to systemic blood flow ratio changes: (tables 52, 53, 54, figure 22)

In group I, At 5 minutes after induction (as baseline), it was 2.03 ± 1.28. 15 minutes after drug administration, it increased significantly to a mean of 3.60 ± 3.29.

In group II, At 5 minutes after induction (as baseline), it was 2.65 ± 1.63. 15 minutes after drug administration, it increased significantly to a mean of 4.27 ± 3.24.

Comparison between the two groups revealed no statistically significant difference at 5 minutes after induction and 15 minutes after drug administration (p=0.136, 0.168 respectively).

Table (52): Pulmonary to systemic blood flow ratio changes in Group I.

Case number	After 5	After 15
1	1	10
2	2.444	2.75
3	1.5	1.636
4	6.333	14
5	2.25	2.5
6	1	2
7	1.833	2.333
8	2	2.333
9	1.85	3
10	2.2	3
11	3.556	4.75
12	1.625	1.75
13	2.333	3
14	0.75	1.167
15	1	1.333
16	2	4
17	0.933	1.167
18	2	4
Min. – Max.	0.75 – 6.33	1.167 – 14.0
Mean ± SD.	2.03 ± 1.28	3.60 ± 3.29
Median	1.93	2.63
Z	3.724*	
p	<0.001*	

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

Table (53): Pulmonary to systemic blood flow ratio changes in Group II.

Case number	After 5	After 15
1	1.5	4
2	1.333	2.25
3	2.063	7
4	0.818	1.75
5	1.571	2
6	2	3.5
7	2	3.5
8	2.182	2.5
9	7	15
10	2.25	2.5
11	3.667	5
12	2.053	2.591
13	3.75	4
14	2.8	4
15	6.333	9
16	2	3
17	1.9	2.4
18	2.509	2.944
Min. – Max.	0.818 – 7.0	1.75 – 15.0
Mean ± SD.	2.65 ± 1.63	4.27 ± 3.24
Median	2.06	3.25
Z	3.724[*]	
p	<0.001[*]	

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

Table (54): Pulmonary to systemic blood flow ratio changes in the two studied groups.

	Group I (n=18)	Group II (n=18)	Z	p
After 5				
Min. – Max.	0.75 – 6.33	0.818 – 7.0		
Mean ± SD.	2.03 ± 1.28	2.65 ± 1.63	1.491	0.136
Median	1.93	2.06		
After 15				
Min. – Max.	1.167 – 14.0	1.75 – 15.0		
Mean ± SD.	3.60 ± 3.29	4.27 ± 3.24	1.380	0.168
Median	2.63	3.25		

Z: Z for Mann Whitney test
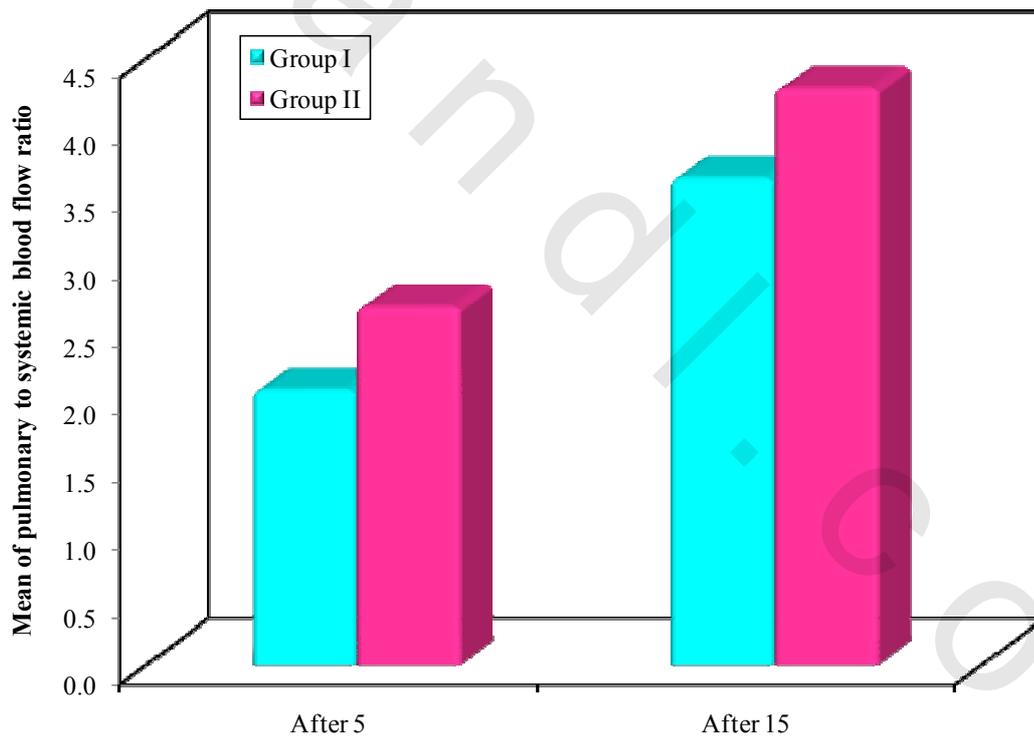P value significant if ≤0.05

Figure (22): Pulmonary to systemic blood flow ratio changes in the two studied groups.