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Effects of pleural opening on respiratory function tests in cardiac surgery: a prospective study

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Abstract. – PURPOSE: To show the effects on lung function of the opening pleura in patients undergoing cardiac surgery.

SUBJECTS AND METHODS: 66 patients were included. Patients were allocated into two groups. In group 1 (n=21) pleura was intact, in group 2 (n=45) pleura was opened. Both groups were compared prospectively in terms of preoperative and on the post-operative 5th day pulmonary function tests (PFT), preoperative, postoperative first and fifth day arterial blood gas analysis, preoperative and postoperative first day mixt venous oxygen saturation, bleeding, operation periods, pulmonary complications, intensive care and hospital stay period and mortality.

RESULTS: There was significant decrease in all PFT indicators on 5th post-operative day in group 2 ($p < 0.01$). Although there was a significant decrease in FEV_1 on 5th post-operative day in group 1 ($p < 0.001$), other pulmonary functions parameters were not change significantly ($p > 0.025$). In group 2 much more decline in pulmonary function test parameters than group 1 were observed ($p < 0.05$). There was not statistically significant difference in blood gas analysis and mixed venous oxygen saturation values in group 1 ($p > 0.05$). But in group 2 except pH and $PaCO_2$, other blood gas measurements were significantly decreased on the postoperative first and fifth day ($p < 0.008$). In group 2 except pH and PCO_2, other parameters were less than the other Group ($p < 0.01$). The drained amount was still significantly higher in group 2 ($p < 0.001$). The frequency of the revision due to bleeding was observed much more in group 2.

CONCLUSIONS: Protection of the integrity of pleura may have positive effects on pulmonary functions in cardiac surgery.

Key words:
Pleuratomy, Cardiac surgery, Intact pleura.

Introduction

The prevalence of post-operative respiratory dysfunction in open-heart surgery is 5-20%[1]. Respiratory dysfunction occurs due to effects of general anesthesia, surgical trauma, median sternotomy and cardiopulmonary by-pass on lungs. Atelectasis secondary to above reasons, increased lung fluid volume, decreased lung volume and increased respiratory work effects respiratory parameters in the post-operative period. There are a few studies regarding effects of preservation of pleural integrity in order to avoid post-operative respiratory dysfunction on respiratory functions, and various ideas are present[2-7]. In this study, we aimed to evaluate the differences between post-operative respiratory functions with intraoperative opened pleura and intraoperative non-opened pleura.

Patients and Methods

This study was conducted in cooperation of Cardiovascular Surgery and Anesthesiology and Reanimation Departments. Informed consents were obtained before initiation of treatment. Necessary protocols and reports were prepared and Education Plan and Coordination Committee's approval was obtained. Pleura was tried to keep intact during surgery. A total of 66 subjects were enrolled. Subjects without opened-pleura constituted extrapleural group, Group 1 (n=21), and subjects with opened pleura during sternotomy or left anterior thoracic artery (LITA) har-

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vesting constituted Group 2 (n=45). Subjects with severe heart insufficiency, hyperthyroidism, collagen tissue disease, severe pulmonary-renal-hepatic disease, history of admission for emergency surgery, reoperations, left ventricle ejection fraction (LVEF) below 40% were excluded from the study.

Anesthesia and Surgery Protocol

Premedication was performed to all subjects one night before the surgery as oral 10 mg diazepam and 1 hour before the surgery as 5 mg morphine sulphate intramuscular (I.M.). Patients were prepared appropriately according to standard anesthesia protocol. Anesthesia induction was maintained with 0.1 mg/kg midazolam, 10 microgram/kg phentanyl and 0.1 mg/kg rocuronium and tracheal intubation was performed. Ventilator adjustment values after tracheal intubation were adjusted as follows: O_2 fraction: 0.5; tidal volume: 10-12 ml/kg; and respiratory rate 8-10/min. Mechanical ventilation was started. Optimum dose was maintained as 0.5 mg phentanyl before sternotomy and 0.5 mg phentanyl, 2 mg rocuronium intravenous (IV) every 45 minutes.

Anti-coagulation was maintained for cardiopulmonary by-pass (CPB) and off-pump surgery subjects with 400 IU/kg and 200 IU/kg Heparin HCl administration, respectively. The same membrane oxygenator and circulatory lines (Dideco, Mirandola, Italy) were used in all CPB subjects. As the prime solution reservoir and lines were filled with 1500 ml Ringer Lactate solution and 30 mEq $HC0_3$, 1 g Vit-C, 1 gr Cefazolin, 2.5 ml/kg Mannitol and 50 IU/kg Heparin were added. CPB was performed with a roller pump (Jostra HL 20, Lund, Sweden) with flow output of 2.4 lt/m^2/min. Mean systemic arterial pressure was maintained between 50-70 mmHg. Mild hypothermia was applied to maintain mean body temperature at 31°C. Erytrocythe suspension (ES) was added in time of need necessary in order to maintain hemoglobin (Hgb) and hematocrit (HCT) levels at 8-10 g/dl and 25-30%, respectively. For myocardial protection of CPB subjects, 10-12 ml/kg cardioplegia solution (Plegisol, Abbott Laboratories, North Chicago, IL, USA) at 10°C, containing 16 mEq/lt potassium with pH value maintained at 7.8 with 10 mEq bicarbonate addition was administered half from aort radix and half from sinus catheter. Concomitant topical cooling was applied at +4°C with physiological saline solution. Afterwards, blood cardioplegia, prepared with 3.6 mEq potassium and 100 ml Plegisol addition to 300 ml blood from CPB catheter, was administered from coronary sinus catheter. Terminal hot cardioplegia of 36°C was administered via coronary sinus immediately before opening aortic cross clamp (XCL).

All patients underwent standard surgical procedure by the same surgical team. The distribution of surgical procedures to groups is shown in Table I. In subjects with coronary surgery; left anterior descending (LAD) artery was by-passed with left internal thoracic artery (LITA) with pedicle; vena saphena magna was used as bypass graft for other arteries. LITA graft was utilized in 10 (47.6%) and 42 (93.3%) subjects in Group 1 and Group 2, respectively. Nineteen subjects in Group 1 (90.5%) and 32 subjects in Group 2 (71.1%) underwent surgery with CPB.

Post-operative Care

All patients were transferred to intensive care unit (ICU) post-operatively. Ventilation parameters in ICU were adjusted as follows: 12-14 respiration/min, inspiratory/expiratory ratio: ½, tidal volume (TV): 10 mL/kg, FiO_2 40%. Patients were extubated when extubation criteria were met. All patients had same respiratory therapy at least twice/day. Patients were actively mobilized on the 1st post-operative day. Mediastinal and thoracal tubes were removed on the 1st and 2nd post-operative days according to drained amount.

Table I. Distribution of operations.

Operations	Group 1	Group 2
CABG	10	38
CABG + CEA		1
CABG + Supracoronary graft		1
CABG + Mitral valve repair		1
CABG + MVR + Aortic valve repair		1
MVR	3	
MVR + ASD repair	1	
AVR		1
AVR + Supracoronary graft		1
AVR + Mitral valve repair	1	
AVR + Assending aorta plication	1	
Aortic valve repair + Supracoronary graft		1
Benthall	1	1
ASD repair		1
Coronary fistula repair	1	
Mixoma excision	1	
Total	***21***	***45***

Demographic Characteristics and Parameters

All patients were pooled regarding age, gender, body mass-index (BMI), smoking, diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), hypertension (HT), cerebrovascular accident (CVA) appearance and complete blood count (CBC), biochemistry and LVEF were studied. Mechanical ventilation mode was (TV, frequency, FiO_2) adjusted as standard depending on subject's weight. Surgery, CPB, XCL, intubation, admittance in ICU, hospitalization period, post-operative drained amount, administered fresh frozen plasma (FFP), electrolytes (ES), whole blood amounts were recorded. Patients were followed regarding development of pulmonary complication (atelectasis and pleural effusion).

Evaluation of Pulmonary Functions

All subjects were questioned about presence of acute or chronic pulmonary disease or smoking in the pre-operative period. All subjects underwent Respiratory Function Tests in the pre-operative period and on the post-operative 5^{th} day and FEV_1, FEV_1/FVC, FEF_{25-75}, FVC values were studied. A portable spirometer was used and evaluation was performed according to American Thoracic Society standards. Arterial blood gas (pH, PaO_2, $PaCO_2$, SO_2, SPO_2) values were studied at room temperature pre-operatively and on the 1^{st} and 5^{th} post-operative days. PaO_2/FiO_2 values were calculated to evaluate alveolo-arterial gas exchange. Mixed venous oxygen saturations ($MVSO_2$) on the pre-operative period and post-operative first days were recorded. Additionally, chest X-rays were evaluated for pre-operative evaluation and post-operative controls.

Post-operative Pain Follow-up and Treatment

Pain scores of subjects in the post-operative period were evaluated with post-extubation Visual Analog Scale (VAS). Patients were in intubated state post-operatively; therefore, 0.1 μg/kg fentanyl was administered intravenously as analgesic. Diclofenac 75 mg, IM, was administered according to VAS score after extubation.

Statistical Analysis

Data analysis was performed with SPSS for Windows 11.5 software (SPSS Inc., Chicago, IL, USA). Proximity of continuous variables to normal range was studied by Shapiro-Wilk test. Definitive statistics were expressed as mean ± standard deviation or median (minimum-maximum) and categorical variables were expressed as case number and (%). The importance of difference between groups regarding mean values and median values were studied with Student's *t* test and Mann-Whitney U test, respectively. The presence of statistically significant difference between groups in pre-operative and post-operative measurements was evaluated with Related *t* test or Wilcoxon Signed-Rank test. The presence of statistically significant difference in pre-operative, post-operative first day and post-operative fifth day measurements was evaluated by Friedman's test. Wilcoxon Signed-Rank test is used to identify the cause of the difference in case the Freidman test statistics is significant. Categorical variables were studied with Pearson's chi-Square test or Fischer's Exact chi-Square test. The statistical significance was accepted as $p < 0.05$. However, Bonferroni Correction was done in order to control Type-I error in all possible multiple comparisons.

Results

Heart surgeries and demographic characteristics of the two groups are shown in Table I and Table II, respectively. Distribution of demographic characteristics of the groups was homogeneous ($p > 0.05$).

Comparing the operative and post-operative data, no statistical difference was observed between two groups other than number of LITA use ($p < 0.001$), drained amount on the post-opera-

Table II. Democraphics.

Variables	Group 1 (n=21)	Group 2 (n=45)	*p*
Age	57.5±12.8	59.8±10.7	0.454
Sex			
– *Male*	15 (71.4%)	39 (86.7%)	0.175
– *Female*	6 (28.6%)	6 (13.3%)	
BMI	27.8±7.0	27.3±4.2	0.743
Smoking	9 (42.9%)	21 (46.7%)	0.772
DM	5 (23.8%)	12 (26.7%)	0.805
COPD	4 (19.0%)	4 (8.9%)	0.253
HT	8 (38.1%)	23 (51.1%)	0.324
SVO	2 (9.5%)	1 (2.2%)	0.236
Ef	60 (40-65)	55 (40-65)	0.294

Table III. Operative and postoperative data.

Variables	*Group 1*	*Grup 2*	*p*
Operation Duration (minutes)	245 (140-780)	240 (120-480)	0.649
CPB (minutes)	99.7±38.6	98.7±34.0	0.926
XCL (minutes)	76.3±26.8	66.9±25.2	0.224
LITA	10 (%47.6)	42 (%93.3)	< 0.001
On CPB	19 (%90.5)	32 (%71.1)	0.117
Entubation time (hour)	11 (5-23)	10 (5-18)	0.724
Post-op drainage 1st day (mL)	500 (250-1050)	800 (150-6000)	< 0.001
Post-op drainage 2 nd day (mL)	50 (50-500)	150 (50-1350)	0.067
Blood products	4 (2-13)	4 (2-11)	0.195
ICU stay (day)	1 (1-4)	1 (0-2)	0.445
Hospital stay (day)	6 (5-9)	6 (5-11)	0.801
Revision due to bleeding	0	5 (%11.1)	< 0.001
Atelectasis	5 (23.8%)	12 (26.7%)	0.805
Pleural effusion	2(9.5%)	13(28.9%)	0.117
Mortality	0	0	

tive first day ($p < 0.001$) and number of revisions due to bleeding ($p < 0.001$) (Table III). LITA was harvested from 10 patients in group 1 (47.6%) and 42 patients in Group 2 (93.3%) and statistically significant difference was present between groups ($p < 0.001$). The first day drainage amounts (800 mL) were significantly higher in group 2 in comparison with Group 1 (500 mL) ($p < 0.001$). No patients in group 1 had revision due to bleeding while 5 patients in Group 2 (11.1%) underwent revision due to bleeding and significant difference was observed between groups ($p < 0.001$). The five patients in group 2, who underwent surgery due to bleeding, were ignored and re-evaluation was performed. As a result of this evaluation the drained amount on the first post-operative day was still significantly higher in group 2 ($p < 0.001$).

There was no statistical difference in laboratory measurements between groups during the observation period (Table IV).

Evaluating the respiratory function tests between groups; there was significant decrease in FEV1 on the 5th post-operative day in comparison with pre-operative value in group-1 ($p < 0.001$). Other PFT indicators were free of significant change according to Bonferroni Corrections ($p > 0.025$). There was significant decrease in all PFT indicators on 5th post-operative day with respect to pre-operative period in group 2. The decrease in PFT indicators in Group 2 was significantly higher than in group 1 ($p < 0.05$) (Table V).

No statistically significant difference was observed in arterial blood gases in Group 1 between pre-operative, 1st post-operative day and 5th post-operative day measurements ($p > 0.05$). There

Table IV. Labaratory measurements.

Variables	*Groups*	*Pre-op*	*Post-op*	p^{a*}	*Change*	p^{b**}
Hemoglobin	1	12.7±1.91	9.8±0.98	< 0.001	-2.9±2.15	0.518
	2	13.5±1.35	10.2±1.35	< 0.001	-3.2±1.58	
Hematocrit	1	39.4±5.80	30.3±3.67	< 0.001	-9.1±6.66	0.374
	2	41.0±3.92	30.5±4.03	< 0.001	-10.5±4.94	
INR	1	1.0 (0.9-1.13)	1.1 (1.0-1.73)	< 0.001	0.1 (-0.1 – 0.7)	0.501
	2	0.96 (0.8-1.19)	1.0 (0.9-2.3)	< 0.001	0.1 (-0.3 – 1.2)	
Urea	1	40.0 (19.0-53.0)	36.0 (20.0-67.0)	0.952	0.0 (-20.0 – 17.0)	0.956
	2	40.0 (16.0-92.0)	38.0 (16.0-186.0)	0.942	0.0 (-44.0 – 131.0)	
Platelet	1	265.0 (150.0-402.0)	186.0 (115.0-296.0)	< 0.001	-79.0 (-192.0 – -5.0)	0.470
	2	253.0 (125.0-1411.0)	176.0 (84.0-503.0)	< 0.001	-89.0 (-1209.0 – 4.0)	
Creatine	1	0.9 (0.5-1.0)	0.8 (0.5-1.2)	0.844	0.0 (-0.2 – 0.3)	0.705
	2	0.9 (0.5-1.6)	0.9 (0.3-2.6)	0.612	0.0 (-0.3 – 1.6)	

*a Comparisons between pre-op and post-op periods.
**b Comparisons between groups in terms of the changes in post-op period according to the pre-op period.
According to the Bonferroni adjustments $p < 0.025$ is accepted as statistically significant.

Table V. Pulmonary function test measurements.

Variables	Groups	Pre-op	Post-op 5th day	p[a*]	Change	p[b**]
FEV_1	1	83.0 (37.0-120.0)	80.0 (35.0-105.0)	< 0.001	-3.0 (-19.0 – 5.0)	0.049
	2	90.0 (35.0-136.0)	81.0 (36.0-102.0)	< 0.001	-8.0 (-46.0 – 10.0)	
FEV_1/FVC	1	88.4 (60.0-98.2)	85.0 (60.2-96.0)	0.140	-1.4 (-7.5 – 9.2)	0.010
	2	83.4 (40.2-100.0)	80.6 (48.2-92.2)	0.002	-4.3 (-29.0 – 49.9)	
FEF (25-75)	1	79.0 (17.0-150.0)	83.0 (14.0-138.0)	0.135	0.0 (-12.0 – 7.0)	< 0.001
	2	79.0 (37.0-185.0)	73.0 (12.0-126.0)	< 0.001	-7.0 (-63.0 – 36.0)	
FVC	1	80.0 (44.0-116.0)	86.0 (40.0-104.0)	0.034	-2.0 (-22.0 – 6.0)	0.005
	2	86.0 (28.0-133.0)	74.0 (34.0-103.0)	< 0.001	-7.0 (-68.0 – 6.0)	

*a Comparisons between pre-op and post-op periods.
**b Comparisons between groups in terms of the changes in post-op period according to the pre-op period.
According to the Bonferroni adjustments $p < 0.025$ is accepted as statistically significant.

was statistically significant difference between the arterial blood gas parameters on the first and fifth post-operative days compared with preoperative period, except the pH and pCO_2 values in Group 2 (Table VI). Significant decrease was evident in group 2 regarding first post-operative and fifth post-operative PaO_2, SO_2, SPO_2 ve PaO_2/FiO_2 values with respect to pre-operative values ($p < 0.008$). Significant decrease was evident regarding fifth post-operative PaO_2, SO_2, SPO_2 ve PaO_2/FiO_2 values with respect to post-operative first day values ($p < 0.008$). There was no change in $MVSO_2$ (pulmonary artery oxygen saturation) values in group 1, while significant decrease was observed on the first post-operative day in group 2 (Table VI).

Group 1 and group 2 were compared regarding blood gas parameters. All blood gas measurements, except pH and PCO_2, showed significant decrease in 1st post-operative values in comparison with pre-operative values and in post-operative fifth day values in comparison with pre-operative values in group 2 with respect to group 1 ($p < 0.01$) (Table VII).

Discussion

Pulmonary dysfunction shows restrictive pattern after open-heart surgery and has 5-20% prevalence[1]. There are various applications in order to prevent pulmonary dysfunction, starting from the pre-operative period. These include giving-up smoking, pre-operative prophylactic inspiratory muscle training[8], breathing techniques[9,10], incentive spirometry applications[11],

Table VI. Arterial blood gas measurements.

Variables	Groups	Pre-op	Post-op 1th day	Post-op 5th day	p
pH	1	7.39 (7.08-7.52)	7.44 (7.36-7.62)	7.40 (7.36-7.46)	0.611
	2	7.42 (7.35-7.48)	7.42 (7.36-7.49)	7.40 (7.34-7.51)	0.052
PaO_2	1	69.0 (50.0-100.0)	76.0 (51.0-99.0)	72.0 (52.0-101.0)	0.455
	2	74.0 (60.0-100.0)[a*,b**]	68.0 (50.0-102.0)[a,c***]	65.0 (50.0-83.0)[b,c]	< 0.001
$PaCO_2$	1	35.0 (28.0-47.0)	35.0 (29.0-43.0)	35.0 (26.0-43.0)	0.987
	2	35.0 (30.0-42.0)	34.0 (30.0-55.0)	34.0 (23.0-44.0)	0.082
SO_2	1	95.0 (83.0-99.0)	97.0 (89.0-99.0)	96.0 (90.0-99.0)	0.294
	2	96.0 (92.0-99.0)[a,b]	95.0 (85.0-99.0)[a,c]	94.0 (89.0-99.0)[b,c]	< 0.001
SPO_2	1	95.0 (84.0-99.0)	96.0 (89.0-99.0)	95.0 (89.0-99.0)	0.214
	2	95.0 (92.0-99.0)[a,b]	94.0 (88.0-98.0)[a]	93.0 (88.0-96.0)[b]	< 0.001
PaO_2/FIO_2	1	345.0 (250.0-500.0)	380.0 (255.0-495.0)	360.0 (260.0-500.0)	0.455
	2	370.0 (300.0-500.0)[a,b]	340.0 (250.0-510.0)[a,c]	325.0 (250.0-415.0)[b,c]	< 0.001
Mixed Venous O_2	1	70.0 (62.0-80.0)	70.0 (61.0-75.0)	–	0.418
	2	72.0 (63.0-82.0)	69.0 (60.0-74.0)	_	< 0.001

*a Between pre-op and post-op 24th hour sample difference is statistically significant ($p < 0.001$).
** b Between pre-op and post-op 5th day sample difference is statistically significant ($p < 0.001$).
*** c Between post-op 24th hour and post-op 5th day sample difference is statistically significant ($p < 0.0083$).

Table VII. According to Pre-op period Post-op Change in Arterial Blood Gas.

Variables	Group 1	Group 2	*p*
pH			
Post-op 24th hour	0.0 (-0.05 – 0.30)	0.01 (-0.08 – 0.07)	0.841
Post-op 5th day	0.0 (-0.07 – 0.37)	-0.01 (-0.12 – 0.07)	0.653
PaO_2			
Post-op 24th hour	0.0 (-11.0 – 37.0)	-6.0 (-20.0 – 17.0)	< 0.001
Post-op 5th day	1.0 (-15.0 – 26.0)	-8.0 (-31.0 – 5.0)	< 0.001
$PaCO_2$			
Post-op 1st day	0.0 (-11.0 – 6.0)	-1.0 (-6.0 – 15.0)	0.884
Post-op 5th day	0.0 (-12.0 – 7.0)	-2.0 (-15.0 – 13.0)	0.192
SO_2			
Post-op 1st day	0.0 (-4.0 – 6.0)	-1.0 (-10.0 – 3.0)	0.003
Post-op 5th day	0.0 (-4.0 – 7.0)	-2.0 (-5.0 – 3.0)	< 0.001
SPO_2			
Post-op 1st day	0.0 (-4.0 – 5.0)	-1.0 (-8.0 – 4.0)	< 0.001
Post-op 5th day	0.0 (-4.0 – 5.0)	-2.0 (-5.0 – 1.0)	< 0.001
PaO_2/FIO_2			
Post-op 1st day	0.0 (-55.0 – 165.0)	-30.0 (-103.0 – 90.0)	< 0.001
Post-op 5th day	5.0 (-75.0 – 165.0)	-40.0 (-155.0 – 25.0)	< 0.001
Mixed Venous O_2			
Post-op 1st day	-1.0 (-10.0 – 8.0)	-3.0 (-9.0 – 3.0)	0.004

*a Between pre-op and post-op 24th hour sample difference is statistically significant ($p < 0.001$).
** b Between pre-op and post-op 5th day sample difference is statistically significant ($p < 0.001$).
*** c Between post-op 24th hour and post-op 5th day sample difference is statistically significant ($p < 0.0083$).

positive inspiratory and expiratory pressure applications via mask[12], medications and inhalation treatments.

Güllü et al[13] showed that non-preserved pleural integrity in coronary surgery patients negatively effects fifth post-operative FEV_1 (%) values and FEV_1/FVC ratios. Another study by Ozkara et al[14] indicated that non-preserved pleural integrity effects FVC, FEV_1 and arterial oxygen pressure values negatively. The authors associated this effect with decreased intrapulmonary shunt and appearance of atelectasis in patients with intact pleura[14]. In our study, we revealed that preserving pleural integrity in open-heart surgery positively effects post-operative FEV_1, FEF (25-75), FVC values and PaO_2, SO_2, SPO_2, PaO_2/FiO_2 and $MVSO_2$ values. However, unlike other studies, our study showed no difference in occurrence of atelectasis and pleural effusion between groups.

Pleural opening requires chest tube placement in respective thoracic region. Chest tube placement damages parietal pleura and intercostal muscles. During respiration movement of the tube which placed between the ribs irritates intercostal nerves and costal periosteum, and causes pain[6,15]. Pain causes more superficial respiration of the patient, which explains deterioration of PFT and blood gas values in these patients. Prevention of pain caused by tube and enabling deeper respiration improves respiratory functions. In our study, post-operative pain was reduced with the same method. There was no significant difference in VAS values between groups. However, we suggest that lack of chest tube need and presence of deeper respiration in patients with preserved pleural integrity, positively effects respiratory functions.

Totaro et al[16] showed that post-operative bleeding is less in patients with preserved pleural integrity. Similar study by Bonacchi et al[17] on 299 patients reported that 7.5% of patients with preserved pleural integrity and 19% of patients with opened pleura had post-operative bleeding of more than 1000 mL. Oz et al[18] showed that post-operative bleeding is more in patients with non-preserved pleural integrity. In our study, post-operative drainage amount was significantly higher in group 2. These results are consistent with our study.

There are several situations in open-heart surgery which may change pulmonary function tests. These include median sternotomy, extracorporeal circulation, expiratory state of lungs during ischemia, blood transfusions, and harvesting of ITA pedicle in some patients[19]. All patients underwent median sternotomy in our study. Lungs were kept in expiratory state during CPB. There was no difference between blood transfusions.

Studies reported that CPB negatively effects respiratory functions in comparison with off-pump surgery[20,21] and systemic inflammatory response syndrome was reported as the cause. Regarding evaluation of CPB use that may affect pulmonary function, 19 patients in group 1 (90.5%) and 32 patients in group 2 (71.1%) underwent CPB. Although negative effects of CPB on lungs is known, in our study, we ignored its effects on respiratory function tests and blood gases because there was no statistical difference between groups regarding number of patients who underwent CPB, and XCL and CPB periods.

Various studies report different results regarding respiratory functions tests and post-operative atelectasis due to LITA harvesting. Bonacchi et al[17] indicated significant pulmonary dysfunction in patients who underwent LITA harvesting and pleura-opening, while Peng et al[25] retrospectively evaluated post-operative chest X-rays of 122 patients and reported similar ratios of pleural effusion in patients with ITA use and sole use of saphenous vein. The Authors claimed that pleural effusion can be seen after CPB regardless of surgical technique. Moreover, they claimed that pleural effusion is secondary to inflammation[25]. In our study, pleural effusion ratios were similar between groups. Regarding LITA harvesting that effects pulmonary functions, patients who underwent LITA harvesting were more in group 2. This result may be secondary to post-operative decrease in respiratory functions.

Conclusions

Post-operative pulmonary complications negatively affect morbidity and mortality. Therefore, protection strategies should be applied to protect respiratory system starting from the preoperative period. In our study, we observed that preserving pleural integrity has positive effects both on respiratory functions and post-operative bleeding. In this respect, more care should be given for preserving pleural integrity in intra-operative period. It may be more beneficial to conduct studies with higher number of subjects on preservation of pleural integrity to show whether pleura-preserving is effective as a surgical technique.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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