Cardiovasc Surg Int 2024;11(x):114-121
http://dx.doi.org/DOI: 10.5606/e-cvsi.2024.1597
www.e-cvsi.org

Cardiovascular Surgery and Interventions

Original Article Open Access

Investigation of effects of different drain materials on postoperative pleural complications and pain in off-pump surgery

Ferhat Borulu[1], Kaptanıderya Tayfur[1], Yusuf Velioğlu[2]

[1]Department of Cardiovascular Surgery, Ordu University Faculty of Medicine, Ordu, Türkiye
[2]Department of Cardiovascular Surgery, Bursa City Hospital, Bursa, Türkiye

Received: January 20, 2024 ***Accepted:*** May 06, 2024 ***Published online:*** May 17, 2024

ABSTRACT

Objectives: This study aimed to investigate whether the need for thoracic tubes placed in the intercostal space, which cause severe pain in the postoperative period and significant problems in pulmonary rehabilitation, could be eliminated by Jackson-Pratt drains placed in the mediastinum in patients who undergo off-pump surgery.

Patients and methods: A prospective analysis of 129 patients (100 males, 29 females; mean age: 62.9±8.5 years; range, 44 to 82 years) who underwent routine off-pump isolated coronary artery bypass grafting surgery between January 2018 and December 2018 was performed. The number of patients who had subxiphoid mediastinal drainage and one mediastinal Jackson-Pratt drainage was 64 (Group 1), and the number of patients who had subxiphoid mediastinal drainage and intercostal chest drainage was 65 (Group 2). Postoperative pain scores, analgesic needs of patients, and radiological effusion and pneumothorax assessments were recorded, and pleural complications requiring invasive intervention were compared.

Results: There was no difference between the groups in terms of age, sex, and comorbidities. There was a significant superiority in Group 2 in terms of pain scoring in the first hour after extubation and the need for analgesia in all follow-up periods ($p<0.001$). In two (3.12%) patients in Group 1 and in two (3.07%) patients in Group 2, pleural effusion requiring intervention was detected. There was no significant difference between the two groups in terms of effusion pneumothorax, in terms of blood transfusion, and other postoperative complications. Postoperative whole blood replacement was higher in Group 2 ($p=0.002$).

Conclusion: In off-pump heart surgery patient groups that do not have a high risk of bleeding, follow-up can be done without inserting an intercostal chest tube as a result of good bleeding control.

Keywords: Beating heart, chest tube, Jackson-Pratt drain, pain.

Cardiovascular diseases are still among the most important causes of mortality and morbidity. The frequency of coronary artery bypass grafting operations, which is the last stage in the treatment of this disease group, is increasing day by day. After cardiac surgery, there may be pain in the sternotomy area and chest where the chest tubes are placed, which may affect the respiratory physiotherapy of the patients. Therefore, control and reduction of pain are crucial to respiratory care, cough, early ambulation, and strengthening deep breath, which is critical to pulmonary recovery.[1-3] The location of the drainage catheters is, therefore, crucial. The removal of chest tubes provides significant reductions in the severity of pain.[4] However, drain placement is necessary after these surgeries to drain the blood from the surgically traumatized areas of the patients, particularly the areas where the internal mammary artery is removed. Nonetheless, due to their firm and rigid structure, conventional chest tubes are capable of restricting postoperative breathing exercises for patients and thereby increasing hypoventilation and atelectasis. It is also thought that it may increase the use of analgesic agents.[5]

Due to their structure, the use of smaller and more flexible silicone drains can be as effective as larger

Corresponding author: Ferhat Borulu, MD. Ordu Üniversitesi Tıp Fakültesi, Kalp ve Damar Cerrahisi Anabilim Dalı, 52200 Ordu, Türkiye
E-mail: fborulu@gmail.com

Citation:
Borulu F, Tayfur K, Velioğlu Y. Investigation of effects of different drain materials on postoperative pleural complications and pain in off-pump surgery. Cardiovasc Surg Int 2024;11(x):114-121. doi: 10.5606/e-cvsi.2024.1597.

and firm drains.[6] These drains are clog-resistant and cause less patient discomfort with their small size and flexibility. In addition, an earlier study showed that the incidence of pericardial effusion, tamponade, and postoperative atrial fibrillation was reduced compared to conventional large drains.[7] This study aimed to evaluate whether postoperative pain level changes and whether complications such as effusion and pneumothorax that require intervention arise due to the drainage placed in the thorax cavity, either intercostal or subxiphoidal.

PATIENTS AND METHODS

This prospective study was performed using two different methods of drainage systems in patients with isolated coronary artery disease who were operated at the Abant İzzet Baysal University İzzet Baysal Training and Research Hospital between January 2018 and December 2018. The patients included in the study were divided into two groups (Groups 1 and 2) and operated by the same surgical team. The groups were determined by drawing lots. The group of the patients was recorded only by the surgical team. The exclusion criteria were as follows: patients requiring additional intervention other than coronary bypass; patients over 80 years of age; patients in which the internal mammary artery was not utilized for various reasons during the operation; patients who had to be returned to on-pump surgery for hemodynamic reasons during the operation; patients with chronic renal failure receiving dialysis treatment; patients who were taken to the operation urgently and who used high doses of anticoagulants or antiaggregants. Initially, 135 patients were included in the study. However, six patients were excluded from the study since they did not attend the postoperative controls. Thus, a total of 129 patients (100 males, 29 females; mean age: 62.9±8.5 years; range, 44 to 82 years) were evaluated, with 64 patients in Group 1 and 65 patients in Group 2.

Anesthesia and surgical technique

Standardized drugs (midazolam, rocuronium, fentanyl, and propofol) were administered to all patients as anesthetic drugs by the same anesthesia team at our institution. All patients were operated on by median sternotomy. The internal mammary artery was used in all patients. The saphenous vein was used for other vessels according to the number of diseased vessels. Off-pump surgery was performed in all patients. After appropriate heparinization (heparin at a dose of 1 mg/kg; activated clotting time was kept at >300 sec), distal anastomoses were performed with octopus support, and proximal anastomoses were performed with a side clamp. After standard bleeding controls, one no. 32 Fr drain and one Jackson-Pratt drain (extending between the posterior part of the heart and the pericardium) were placed to the mediastinum of patients in Group 1. No thorax drain was placed in this group of patients. In Group 2, one no. 32 Fr drain was placed in the mediastinum and one no. 36 Fr drain in the left thorax (through the fifth or sixth intercostal space in the middle axillary region). Heparin neutralization was performed with protamine. The mediastinum was routinely closed in all of the patients in the same way.

Postoperative follow-up

All patients were transferred to the intensive care unit. Pneumothorax was checked by posteroanterior chest radiographs. All patients were extubated at the appropriate time after routine intensive care follow-up. The pain assessment of the patients in the surgical area was started 1 h after the extubation and evaluated every 6 h using a verbal pain category scale indicated in Figure 1, and the scores were recorded.[8] Nonsteroidal pain relievers were administered to patients who responded as feeling a pain level of 2 or 3. Narcotic analgesics (tramadol 50 mg) were administered to patients who indicated a pain level of 4 or 5.

Intensive care follow-up was performed to the same standards. Antiaggregant and anticoagulant postoperative treatment was conducted similarly. Drains were pulled in the last 12 h if there was less than 100 mL of drainage. The first posteroanterior chest radiographs were obtained after the operation. Chest radiographs were renewed

Mild	Discomforting	Distressing	Horrible	Excruciating
1	2	3	4	5

Figure 1. Verbal category scale.[8]

daily until discharge. After the patients were discharged, chest radiographs were taken on the seven- and 30-day controls to see if there was any effusion requiring intervention in the left thorax. Posteroanterior chest radiographs were obtained at discharge, and both posteroanterior and left lateral radiographs were taken in controls after discharge since they were able to show less amount of fluid. Thorax ultrasonography was performed on patients with suspicious appearance on direct radiographs as it is more sensitive. Consultations from the thoracic surgery department were conducted for the patients with effusion findings to discuss whether to intervene. In case of need, pleural drainage procedures were performed by the same surgical team.

Statistical analysis

Statistical analysis was performed using IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Data were reported as mean ± standard deviation (SD), median (interquartile range), or frequency (percentage). The independent sample t-test, chi-square test, Fisher exact test, Mann-Whitney U test, GLM, and repeated analysis of variance measurements were used. The statistical significance level was accepted as $p<0.05$.

RESULTS

The rate of chronic obstructive pulmonary disease was significantly higher in Group 2. The history of a cerebrovascular event was more common in patients in Group 1. There was no significant difference between the other variables (Table 1).

Preoperative laboratory data were compared between the groups. The albumin value was significantly higher in Group 1, and the calcium value was significantly higher in Group 2. There was no significant difference in other baseline values (Table 2).

Effusion requiring drainage was detected in two patients at the first control after discharge in Group 1. In the same group, one patient had minimal pneumothorax without intervention in the left thorax. In Group 2, two patients underwent percutaneous thoracentesis due to significant pleural effusion at the first outpatient control, although there were no patients with pneumothorax. Frequency of these complications was not statistically significant between the two groups.

Although there were no significant differences in the amount of postoperative drainage and

Table 1
Preoperative demographic characteristics and clinical data

	Group 1 (n=64)			Group 2 (n=65)			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			61.6±9.3			63.3±7.3	0.257
Sex							0.558
Male	51	79.7		49	75.4		
Female	13	20.3		16	24.6		
Diabetes mellitus	32	50		24	36.9		0.134
Hypertension	36	56.2		40	61.5		0.541
COPD	1	1.6		9	13.8		**0.009**
Chronic renal failure	0	0		1	1.5		0.504
Peripheral artery disease	7	10.9		2	3.1		0.078
Cigarette	28	43.8		23	35.4		0.331
Cerebrovascular event	6	9.4		0			**0.013**
Hyperlipidemia	8	12.5		12	18.5		0.350
Ejection fraction			51.78±8.88			53.72±7.06	0.351
FEV1/FVC (%)			76.47±3.65			75.57±4.40	0.227

SD: Standard deviation; COPD: Chronic obstructive pulmonary disease; FEV1/FVC: Forced expiratory volume in one second/forced vital capacity.

Table 2
Preoperative laboratory values

	Group 1 (n=64)	Group 2 (n=65)	
	Mean±SD	Mean±SD	*p*
White blood cell (K/mm^3)	8.32±2.32	8.14±2.03	0.906
Hemoglobin (g/L)	13.53±1.58	13.83±1.34	0.260
Hematocrit (%)	41.39±4.84	41.43±4.30	0.960
Platelet (K/mm^3)	231.36±73.27	226.70±56.29	0.849
Blood urea nitrogen (mmol/L)	38.92±13.61	35.34±8.73	0.225
Creatine (µmol/L)	0.94±0.21	0.95±0.24	0.670
Calcium (mmol/L)	9.19±0.47	8.90±1.08	**0.014**
Albumin (µmol/L)	4.04±0.33	4.25±0.57	**0.012**
Protrombin time (sec)	11.50±0.86	11.73±0.90	0.145
Partial thromboplastin time (sec)	26.42±4.91	24.49±2.96	**0.011**
International normalized radio	0.98±0.07	1.03±0.08	**0.001**

SD: Standard deviation.

intraoperative and postoperative blood transfusion, the need for fresh frozen plasma and fresh whole blood in the postoperative period was significantly higher in Group 2 (Table 3). Operation time, postoperative extubation time, postoperative atrial fibrillation frequency, and discharge times were similar in both groups. The number of vessels undergoing anatomic surgery and the length of intensive care unit stay were significantly higher in Group 1 (Table 4). The verbal category scale for the pain assessment of the patients was found to be significantly higher in those in Group 2 in all evaluation periods in the first 48 h (Table 5). Based on the pain rating scale, nonsteroidal analgesia and

Table 3
Blood transfusion and drainage between groups

	Group 1 (n=64)	Group 2 (n=65)	
	Mean±SD	Mean±SD	*p*
Intraoperative			
Plasma	2.33±0.714	2.77±0.425	**0.001**
Whole blood	0.03±0.175	0.15±0.364	0.113
Erythrocytes	0.25±0.563	0.31±0.465	0.188
Postoperative			
Plasma	0.28±0.723	0.40±0.703	0.134
Whole blood	0.03±0.175	0.22±0.414	**0.002**
Erythrocytes	0.59±0.771	0.46±0.588	0.496
Postoperative			
Day 1 drainage	409.84±197.930	394.31±159.099	0.806
Day 2 drainage	152.81±104.76	142.38±64.742	0.867
Day 3 drainage	24.60±51.48	12.50±30.86	0.275
Total drainage	608.75±320.548	551.08±197.271	0.622

SD: Standard deviation.

Table 4
Operational and postoperative follow-up parameters between groups

	Group 1 (n=64)			Group 2 (n=65)			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Operation time (h)			4.10±0.68			4.03±0.68	0.617
Number of vessels (n)			3.81±1.13			3.20±0.93	**0.001**
Atrial fibrillation	17	26.56		18	27.69		0.345
Extubation times (h)			6.07±1.52			5.98±1.14	0.794
Intensive care exit times (h)			61.98±25.329			48.63±10.268	**0.003**
Discharge time (h)			5.69±1.20			5.57±1.43	0.520
Pleural effusion	2	3.1		2	3.07		
Pneumothorax	1	1.56		-	-		

SD: Standard deviation.

narcotic analgesia applications were significantly higher in Group 2 (Table 6).

DISCUSSION

In patients undergoing open heart surgery, a drainage system is necessary to prevent tamponade due to accumulation in the pericardial area and to reduce pleural effusions. The chest drainage system did not change for years due to the presence of severe complications. Although there is a need for tubes to provide drainage, it is also known that these tubes are a significant source of pain in the postoperative period. It may also limit patient activity and cause uneasiness in coughing and deep breathing. This can ultimately cause inadequate expansion of the thoracic cavity and respiratory infections.[9] Studies have not focused on reducing these drains but rather on their consequences. There are studies to reduce the pain caused by drains and the pain that occurs when they are removed.[10] In the present study, we concluded that the need for postoperative chest drain placement, known as the traditional doctrine of open heart surgery, can be eliminated with a conventional drain and Jackson-Pratt drain placed in the mediastinum, particularly in off-pump coronary bypass surgery.

In a study conducted by Guden et al.[11] in 2012, it was shown that both the subxiphoid and intercostal tract could be used to insert a chest tube. Although there are early studies on different locations of the chest tube, no studies have been conducted on not placing drains into the thoracic cavity. Pericardial

Table 5
Comparison of pain scores between groups

	Group 1 (n=64)	Group 2 (n=65)	
	Mean±SD	Mean±SD	*p**
After extubation (h)			
1st	2.23±0.496	2.83±0.525	0.001
6th	1.84±0.672	2.81±0.564	0.001
12th	1.66±0.511	2.71±0.455	0.001
18th	1.27±0.445	2.37±0.548	0.001
24th	1.17±0.380	2.14±0.503	0.001
48th	1.11±0.315	1.90±0.530	0.001

SD: Standard deviation; * Mann Whitney U test.

Table 6
Postoperative pain relief between the groups

	Group 1 (n=64)		Group 2 (n=65)		
	n	%	n	%	*p**
After extubation (h)					
1st	17	26.6	50	79.4	**0.001**
Narcotic analgesia (h)					
6th	10	15.6	47	74.6	**0.001**
12th	1	1.6	43	68.3	**0.001**
18 th	0	0	25	39.7	**0.001**
24th	0	0	12	19.0	**0.001**
48th	0	0	6	9.5	**0.013**
After extubation (h)					
1st	45	70.3	11	17.5	**0.001**
Non steroid analgesia (h)					
6th	34	53.1	17	27.0	**0.001**
12th	40	62.5	17	27.0	**0.001**
18th	17	26.6	36	57.1	**0.001**
24th	11	17.2	45	71.4	**0.001**
48th	7	10.9	44	69.8	**0.001**

SD: Standard deviation; * Pearson chi-square.

tamponade is the most feared complication after cardiac surgery. We were able to execute the study since we used mediastinal drains to eliminate this risk.

In a study by Frankel et al.,[12] no significant difference was evident in intensive care follow-ups between the patients who were using classical chest tubes and flexible silastic drains. In our study, although there was a significant difference in terms of length of stay in the intensive care unit in favor of the patients in Group 1, it did not affect our results since it was not one of the main evaluation points of this study.

There was a significant difference in pain scores and analgesia needs, particularly in the postoperative follow-up period and until the drains were removed. There was a significant decrease in pain in Group 1 starting at the first hour after the intubation and in the type and amount of analgesia performed. In a study conducted by Bjessmo et al.,[13] no significant difference was reported in the assessment of pain with the use of two different drains. There are contradictory results in the literature on this subject. Some studies support the results of our study.[14,15] Although there was a significant increase in the duration of intensive care unit stay in Group 1, significant improvements were observed in patients in Group 2 in terms of treatment compliance, mobilization, and compliance with respiratory physiotherapy exercises. These data suggest that this is due to low levels of pain and analgesic needs of patients. Pulmonary hypoventilation findings may occur due to decreased pulmonary function of patients due to trauma in bone and muscle during surgery.[16] The location of the drain to be placed in the thoracic cavity has been well studied, and in our study, effusion, which required thoracentesis on the fifth postoperative day, was detected only in two patients after the drainage was not placed in the thorax cavity. Only one patient developed left minimal pneumothorax that did not require any intervention and regressed in the follow-up. In the same way, the necessity of thoracentesis was determined and applied to the two patients in the first group after discharge. This suggests that there is no significant difference in pleural complications. Our results are not congruent with a priori knowledge of the necessity of a thoracic tube in classical surgical teaching.

Pleural effusion after cardiac surgery may be due to many causes.[17] However, it is mainly caused by leaks due to trauma in the inner wall of the thoracic wall triggered by the removal of the internal mammary artery. Our study does not focus on the causes of effusion but on whether there is a difference between drain types and accumulated fluid. It is suggested that the absence of a significant hemothorax is due to the fact that there is no adverse effect on the coagulation system in patients due to off-pump surgery and good bleeding control within the operation.

In a study conducted in 2002, no significant difference was reported between flexible silastic drains and classical large drains in terms of pericardial tamponade and pleural effusion.[15] In another study by Moss et al.,[18] similar effusion tamponade results were obtained for both drainage methods. In our study, there was no significant difference in terms of pleural effusion and pericardial tamponade despite the absence of thorax drainage.

One of the common problems after open heart surgery is cardiac arrhythmias with predominantly atrial fibrillation.[19] In the first three days after surgery, there is a significant increase in atrial fibrillation formation.[20] Some studies indicated that the development of atrial fibrillation leaded to a prolonged postoperative intensive care follow-up and discharge times.[21,22] In our study, although the development of atrial fibrillation was higher in percentage, particularly in Group 2, there was no difference between the groups. Since other factors that play a role in the development of atrial fibrillation were not fully compared in our study, it is difficult to make a conclusive comment based only on the types of drains. The fact that there was no significant difference between the two groups in terms of operation times, postoperative intubation times, postoperative stroke, and discharge times made it easier for us to compare postoperative pain and pleural complications.

In Group 2, higher activated prothrombin time and international normalized ratio values in the preoperative period caused an increase in intraoperative fresh frozen plasma and postoperative fresh whole blood transfusion. This situation is incongruent with the studies reported in the literature. Since other parameters were not studied in terms of bleeding, no definitive interpretation could be remarked regarding this condition.

There were several limitations in the present study. The first limitation was the detection of the amount of postoperative effusion by chest radiography, which is known for being not sensitive to effusions of less than 200 mL. This evaluation was first performed by the cardiac surgery team and not by the radiology team. The second limitation was that the follow-up of the patients was not completely blinded, as the same team conducted the follow-ups. The effect of other sources of pain, such as median sternotomy and saphenous incision location, could not be included in the study. In our clinic, a 36 Fr tube was used for the thorax region as a routine procedure. The size and type of chest tubes (36 Fr tube) may have affected the effectiveness of pleural drainage, pain sensation, and associated morbidities.

In conclusion, drains are crucial for patient monitoring in cardiac surgery. We believe that, particularly in off-pump heart surgery patients who do not have a high risk of bleeding, follow-up can be done without inserting an intercostal chest tube if good bleeding control is provided. More comprehensive studies are needed on this subject.

Ethics Committee Approval: The study protocol was approved by the Abant İzzet Baysal University Clinical Researches Ethics Committee (date: 28.12.2017, no: 2017/201). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, design, data collection and/or processing, writing the article: F.B.; Analysis and/or interpretation: K.T.; Control/supervision, analysis and/or interpretation, literature review, critical review: Y.V.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Lahtinen P, Kokki H, Hynynen M. Pain after cardiac surgery: A prospective cohort study of 1-year incidence and intensity. Anesthesiology 2006;105:794-800. doi: 10.1097/00000542-200610000-00026.

2. O'Connor CJ. Pain relief and pulmonary morbidity after cardiac surgery. Crit Care Med 1999;27:2314-6. doi: 10.1097/00003246-199910000-00055.
3. Sasseron AB, Figueiredo LC, Trova K, Cardoso AL, Lima NM, Olmos SC, et al. Does the pain disturb the respiratory function after open heart surgery? Rev Bras Cir Cardiovasc 2009;24:490-6. doi: 10.1590/s0102-76382009000500010.
4. Mueller XM, Tinguely F, Tevaearai HT, Ravussin P, Stumpe F, von Segesser LK. Impact of duration of chest tube drainage on pain after cardiac surgery. Eur J Cardiothorac Surg 2000;18:570-4. doi: 10.1016/s1010-7940(00)00515-7.
5. Casey E, Lane A, Kuriakose D, McGeary S, Hayes N, Phelan D, et al. Bolus remifentanil for chest drain removal in ICU: A randomized double-blind comparison of three modes of analgesia in post-cardiac surgical patients. Intensive Care Med 2010;36:1380-5. doi: 10.1007/s00134-010-1836-2.
6. Sakopoulos AG, Hurwitz AS, Suda RW, Goodwin JN. Efficacy of Blake drains for mediastinal and pleural drainage following cardiac operations. J Card Surg 2005;20:574-7. doi: 10.1111/j.1540-8191.2005.00138.x.
7. Ege T, Tatli E, Canbaz S, Cikirikcioglu M, Sunar H, Ozalp B, et al. The importance of intrapericardial drain selection in cardiac surgery. Chest 2004;126:1559-62. doi: 10.1378/chest.126.5.1559.
8. Melzack R, Katz J. The MC gill pain questionnaire: appraised and current status, handbook of pain assessment. New York: The Guilford Press; 1992. s. 152-168.
9. Gray E. Pain management for patients with chest drains. Nurs Stand 2000;14:40-4. doi: 10.7748/ns2000.02.14.23.40.c2768.
10. Lu HY, Lin MY, Tsai PS, Chiu HY, Fang SC. Effectiveness of cold therapy for pain and anxiety associated with chest tube removal: A systematic review and meta-analysis of randomized controlled trials. Pain Manag Nurs 2024;25:34-45. doi: 10.1016/j.pmn.2023.04.016.
11. Guden M, Korkmaz AA, Onan B, Onan IS, Tarakci SI, Fidan F. Subxiphoid versus intercostal chest tubes: Comparison of postoperative pain and pulmonary morbidities after coronary artery bypass grafting. Tex Heart Inst J 2012;39:507-12.
12. Frankel TL, Hill PC, Stamou SC, Lowery RC, Pfister AJ, Jain A, et al. Silastic drains vs conventional chest tubes after coronary artery bypass. Chest 2003;124:108-13. doi: 10.1378/chest.124.1.108.
13. Bjessmo S, Hylander S, Vedin J, Mohlkert D, Ivert T. Comparison of three different chest drainages after coronary artery bypass surgery--a randomised trial in 150 patients. Eur J Cardiothorac Surg 2007;31:372-5. doi: 10.1016/j.ejcts.2006.12.027.
14. Obney JA, Barnes MJ, Lisagor PG, Cohen DJ. A method for mediastinal drainage after cardiac procedures using small silastic drains. Ann Thorac Surg 2000;70:1109-10. doi: 10.1016/s0003-4975(00)01800-2.
15. Akowuah E, Ho EC, George R, Brennan K, Tennant S, Braidley P, et al. Less pain with flexible fluted silicone chest drains than with conventional rigid chest tubes after cardiac surgery. J Thorac Cardiovasc Surg 2002;124:1027-8. doi: 10.1067/mtc.2002.125641.
16. Cohen AJ, Moore P, Jones C, Miner TJ, Carter WR, Zurcher RP, et al. Effect of internal mammary harvest on postoperative pain and pulmonary function. Ann Thorac Surg 1993;56:1107-9. doi: 10.1016/0003-4975(95)90025-x.
17. Göde S, Yeniterzi M, Kaya M, Satılmışoğlu MH, Güler S, Gül M, et al. Possible causes of major pleural effusion in early period after cardiac surgery. Cardiovascular Surgery and Interventions 2015;.2:21-6.
18. Moss E, Miller CS, Jensen H, Basmadjian A, Bouchard D, Carrier M, et al. A randomized trial of early versus delayed mediastinal drain removal after cardiac surgery using silastic and conventional tubes. Interact Cardiovasc Thorac Surg 2013;17:110-5. doi: 10.1093/icvts/ivt123.
19. Gökşin İ, Saçar M, Baltalarlı A, Sungurtekin H, Özcan V, Adalı F, et al. Determinants of postoperative atrial fibrillation in patients undergoing coronary artery bypass grafting: Prophylactic beta-blocker plus statin therapy for prevention of postoperative atrial fibrillation. Turk Gogus Kalp Dama 2006;14:177-84.
20. Bohatch Júnior MS, Matkovski PD, Di Giovanni FJ, Fenili R, Varella EL, Dietrich A. Incidence of postoperative atrial fibrillation in patients undergoing on-pump and off-pump coronary artery bypass grafting. Rev Bras Cir Cardiovasc 2015;30:316-24. doi: 10.5935/1678-9741.20150040.
21. Mariscalco G, Engström KG. Postoperative atrial fibrillation is associated with late mortality after coronary surgery, but not after valvular surgery. Ann Thorac Surg 2009;88:1871-6. doi: 10.1016/j.athoracsur.2009.07.074.
22. Barbieri LR, Sobral ML, Gerônimo GM, Santos GG, Sbaraíni E, Dorfman FK, et al. Incidence of stroke and acute renal failure in patients of postoperative atrial fibrillation after myocardial revascularization. Rev Bras Cir Cardiovasc 2013;28:442-8. doi: 10.5935/1678-9741.20130073.