ORIGINAL ARTICLE

Comparison consequences of Jackson-Pratt drain versus chest tube after coronary artery bypass grafting: A randomized controlled clinical trial

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Background: Chest tubes are used in every case of coronary artery bypass grafting (CABG) to evacuate shed blood from around the heart and lungs. This study was designed to assess the effective of Jackson-Pratt drain in compare with conventional chest drains after CABG. **Materials and Methods:** This was a randomized controlled trial that conducted on 218 patients in Chamran hospital from February to December 2016. Eligible patients were randomized in a 1:1 ratio. Jackson-Pratt drain group had 109 patients who received a chest tube insertion in the pleural space of the left lung and a Jackson-Pratt drain in mediastinum, and Chest tube drainage group had 109 patients who received double chest tube insertion in the pleural space of the left lung and the mediastinum. **Results:** The incidence of pleural effusions in Jackson-Pratt drain group and chest tube group were not statistically different. The pain score at 2-h in Drain group was significantly higher than chest tube group (P = 0.001), but the trend of pain score between groups was not significantly different (P = 0.097). The frequency of tamponade and atrial fibrillation (AF) were significantly lower in Jackson-Pratt drain group (P < 0.05). **Conclusion:** The Jackson-Pratt drain is equally effective for preventing cardiac tamponade, pleural effusions, and pain intensity in patients after CABG when compared with conventional chest tubes, but was significantly superior regarding efficacy to hospital and Intensive Care Unit length of stay and the incidence of AF.

Key words: Coronary artery bypass grafting, chest-tube, Jackson-Pratt drain

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INTRODUCTION

Todays, cardiovascular disease is known as one of the main causes of deaths around the world. WHO estimated that in 2020, cardiovascular disease will cause 25 million deaths and in the elderly accounts for a fifth of disabilities.[1,2] In patients with higher stages of coronary artery disease, coronary artery bypass grafting (CABG) is the most common type of open-heart surgical interventions. Since 1980, the number of CABG surgeries has increased more than 5-fold, and in each year, almost steady rise has been observed in CABG surgeries.[3]

After CABG, iatrogenic injuries to the pleura and the harvesting of the left internal thoracic artery necessitate the placement of chest tubes. Hence, regularly after surgery, chest tubes are inserted to ensure effective drainage of fluid and air from the chest cavity and earlier detection of postoperative bleeding, prevent cardiac tamponade, and possibly to prevent the development of early postoperative pleural effusions after surgery.[4-6] Depending on the method and criteria used for assessment, pericardial effusion is reported to be between 1% and 85%, after cardiac surgery, and delayed cardiac tamponade has been reported to be as high as 15%.[7,8] Significant pericardial effusion and delayed cardiac tamponade are associated with an increased incidence of atrial fibrillation (AF), prolonged hospitalization and rehospitalization.[9] Conventionally, large semi-rigid chest tubes are used to prevent these complications. Chest tubes are potentially a source of pain and irritation for patients, that might cause

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hypoventilation, atelectasis, and increased the use of sedatives and analgesic agents.[10]

There are reports supporting that the use of smaller and softer silicone drains are as effective as larger drains after cardiac surgery.[11] Jackson-Pratt drain (Ethicon, USA) is a soft silastic tube with four lateral channels, and a solid core center that is resistant to occlusion and by its small size and flexibility may result in less patient discomfort. One study shows that these drains are associated with a decreased incidence of pericardial effusion, tamponade, and postoperative AF and are more effective than conventional large drains.[12] Other studies reported that these drains are as effective as larger drains, or are less effective.[13-17]

Now, few studies with conflict results have addressed the safety and efficacy of Jackson-Pratt drain after cardiac surgery. Hence, the present study was designed to assess the effective of Jackson-Pratt drain in compare with conventional chest drains after CABG.

SUBJECTS AND METHODS

Study design and participants

The study was a prospective, parallel group, randomized controlled, clinical trial, that conducted on 218 patients who have undergone CABG surgery in Chamran hospital affiliated to the Isfahan University of Medical Sciences from February to December 2016. Ethical approval was obtained from the research ethics committee before recruitment.

All consecutive patients were included in the study according to the following inclusion criteria:[1] Patients undergoing primary CABG.[2] Patients in both gender with age between 18 and 75 years old,[3] CABG only surgery, and[3] able to give informed consent. The exclusion criteria were the presence of congenital heart disease, patients undergoing a second heart surgery, and prior treatment with anticoagulants. Furthermore, patients who were not able to give informed consent were excluded from the study. All eligible patients were voluntary and gave written informed consent to participate in the trial, before the start of the intervention. Random allocation was done by a randomization sequence generated by Random Allocation Software.

Procedures

Enrolled patients were randomly assigned to one of the two equal groups. Group I (Jackson-Pratt drain group) had 109 patients who received a chest tube insertion in the pleural space of the left lung and a vacuum Jackson-Pratt drain in mediastinum; and Group II (chest tube drainage group) had 109 patients who received double chest tube insertion in the pleural space of the left lung and in the mediastinum. The chest tube inserted through the midline inferior to the xiphoid process.

Collected data included age, gender, hospital, and Intensive Care Unit (ICU) length of stay (LOS), tamponade, pleural effusion, pain, AF. Pain score was estimated by the visual analog scale using vertical line with 10 cm length on paper (pain-free state to worst imaginable pain). Studied patients in both groups were visited at 2 h, 24 h, 48 h, and at discharge time for pain assessments. The primary outcomes were rate of pleural effusions, tamponade, and AF in a 4-week postoperative period of Intervention.

This study was approved by Isfahan University of Medical Sciences (Ethical code: [Ir.mui.rec. 1394.3.795).

Statistical analysis

Statistical analysis was done by SPSS for Windows (SPSS, Inc., Chicago, IL, USA, version 23). Descriptive data are reported as mean ± standard deviation, median [IQR] or number (percent) as appropriate. Independent sample *t*-test, Chi-square test, Fisher's exact test, Mann-Whitney U-test, and GLM repeated measurements of ANOVA were used as appropriate. All hypothesis testing was two-tailed and level of significance was considered to be <0.05 in all tests.

RESULTS

A total of 230 patients were reviewed to selected eligible patients; twelve patients did not enter (three refused informed consent, and nine patients were not eligible). Two hundred and eighteen eligible patients assigned into two intervention groups. Fourteen patients were lost during the follow-up period. Finally, 100 patients in Jackson-Pratt drain group and 104 patients in chest tube group completed the study and analyzed [Figure 1].

The mean of age in studied patients was 62.7 ± 8.1 years, 76.7% (138 patients) were male and 23.3% (42 patients) were female. Other demographics, baseline and clinical characteristics of the subjects according to treatment group are shown in Table 1.

Most of the patients in both groups were male, and no significant differences were noted between groups for age ($P > 0.05$).

The frequency of tamponade and AF were significantly lower in Jackson-Pratt drain group ($P < 0.05$).

As shown in Table 1, the pain score was not significantly different between groups at 24-, 48-h and at discharge time ($P > 0.05$) but at 2-h in Drain group was significantly higher than chest tube group ($P = 0.001$). The result of

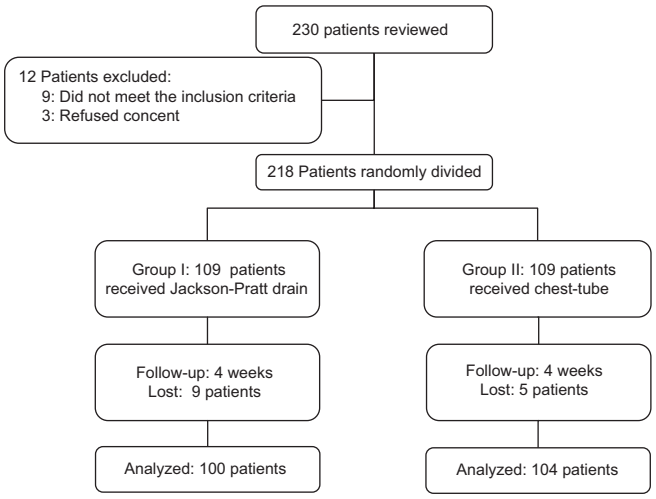

Figure 1: Trial profile of intervention flowchart

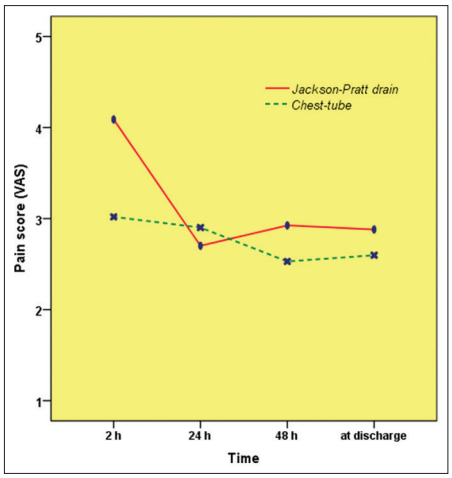

Figure 2: Comparison of pain score trend between studied groups (repeated measures of ANOVA; *P* (intervention) = 0.097), *P* (time < 0.0001); *P* (time × intervention < 0.0001)

Table 1: Demographic and clinical characteristics of studied population by intervention groups

Characteristics	Groups		*P*
	Jackson-Pratt drain (*n*=100)	Chest-tube (*n*=104)	
Age (year)	62.3±8.1	62.9±8.4	0.595*
Gender (male/female)	78/22	80/24	0.854†
Hospital LOS (day)	6 (6-7)	7 (6-10)	<0.0001††
ICU LOS (day)	4 (4-5)	5 (4-7)	0.001††
Tamponade	0	4 (3.8)	0.048†
Pleural effusion	2 (2)	7 (6.7)	0.171**
Pain (VAS)			0.097¥
2 h	5 (2-5)	3 (2-4)	0.001††
24 h	2 (1-4)	2 (2-4)	0.383††
48 h	2 (1-4)	2 (1-4)	0.428††
Discharge	2 (1-4)	2 (1-3)	0.952††
AF	2 (2)	10 (9.6)	0.021†

The data are presented as mean±SD, *n* (%) and median (IQR). *P* values calculated using *Independent sample *t*-test; †Chi-square test; ††Mann-Whitney U-test; **Fisher exact test and ¥GLM repeated measures of ANOVA. LOS = Length of stay; AF = Atrial fibrillation; ICU = Intensive Care Unit; VAS = Visual analog scale; IQR = Interquartile range; SD: Standard deviation

GLM repeated measures of ANOVA shows that the trend of pain score between groups was not significantly different (*P* = 0.097) [Figure 2].

DISCUSSION

In patients after CABG, safe, effective drainage of the chest is necessary to prevent cardiac tamponade, and reduce the incidence of pleural effusions. Despite, the presence of smaller incisions and minimally invasive approaches, use of large rigid chest tubes continues the chest drainage system has not changed for years. There is conflict in literatures results to support the benefits of the use of either silastic drain over the conventional chest tube. Our study illustrates that the patients in Jackson-Pratt drain group experienced significantly lower hospital and ICU LOS and higher pain intensity at first 2 h. There were no significant differences between the Jackson-Pratt drain and conventional chest tube in pleural effusion, tamponade, and pain intensity until discharge. However, the incidence of pleural effusion (2 [2%] vs. 7 [6.7%], respectively; *P* = 0.171) and tamponade (0 vs. 4 [3.8%], respectively; *P* = 0.048) in Jackson-Pratt drain were lower. Patients in Jackson-Pratt drain group had significantly lower percentages of AF in compare to patients in conventional chest tube group (2 [2%] vs. 10 [9.6%]; *P* = 0.021). Hence, lower hospital and ICU LOS, pleural effusion, tamponade, and AF show that Jackson-Pratt drain can be superior to the conventional chest tube after cardiac surgery.

Frankel *et al*., in a retrospective nonrandomized case–control study reported that the LOS in ICU in patients from the silastic drain group was similar to conventional drain groups.[13] This is in conflict to our findings, that shows the significant different in ICU LOS between Jackson-Pratt drain and conventional drain, whereas, patients from the Jackson-Pratt drain had a shorter ICU LOS. Overall hospital LOS in our study like Frankel *et al*., study[13] in patients in silastic drain group was significantly shorter when compared to patients from the conventional drain group. It is suggested that greater ease of ambulation with the silastic drain in the early postoperative period may prevent deconditioning and/or immobility related morbidity allowing for a more rapid discharge.

Use of chest tubes are associated discomfort and pain, and previous studies evaluated the pain intensity after the use of chest tubes after CABG in regard to drains type. In these studies, pain score in silastic drain compared with conventional large chest tubes and reported different results. In Frankel *et al*., study, at 1st day after surgery, pain score in silastic drain reported lower than the conventional drain but the difference had not been statistically significant.[13] In Bjessmo *et al*. study, pain at removal the day after the surgery

was reported to be similar among patients who received plastic or silastic drains.[14] Moss *et al*. also found that pain score was not different between silastic and conventional drains.[9] Some other studies reported less pain with the smaller silastic drains in compare to conventional drains.[15-17] In the present study, after 2 h, pain in Jackson-Pratt drain is significantly higher than conventional drain but after that during the presence of drains pain score was similar between two studied drains. The conventional chest tube, because of its large size and rigidity, restricts breathing and causes sufficient pain following surgery. On the other hand, the silastic drains create in more flexible with a smaller diameter drainage tube that cause to decreased risk of tissue injury and erode into adjacent structures or disrupt anastomosis associated with their use compared to the conventional chest tube. Similarity in pain score between groups in our study may be has been because of different in the doses of necessary analgesics in studied patients, whereas, this was not recorded.

In the present study, Jackson-Pratt drain was as effective as conventional chest tube in regard to the incidence of pleural effusion and tamponade, but AF in Jackson-Pratt drain was significantly lower than conventional chest tube. These finding is in agreement with previous results that often reported the same effects for silastic drains compare to conventional drains. Akowuah *et al*. demonstrated that flexible fluted silicone drains do not lead to an increase in pleural effusions and tamponade.[16] Roberts *et al*. reported high incidence of pleural effusions in both Blake drains and conventional drains, but they demonstrated no differences between the two groups for pleural effusions and tamponade.[17] Moss *et al*. reported that the incidence of significant effusion or tamponade was similar between the Blake group and the conventional group.[9] These findings are similar to our findings. But in Moss *et al*. study[9] AF reported to be similar between studied groups whereas, in our study frequency of AF in Jackson-Pratt drain was significantly lower than conventional group. The similarity between different types of drains in the incidence of pleural effusions may be explain by the fact that chest tubes are not the only cause of pleural effusions in patients after CABG.

The present study had several limitations. First, surgeons and nurses who recorded outcomes were not blinded to the type of drain used. Second, doses of necessary analgesics in studied patients were not recorded, this may be affected the pain score reported by patients. Third, the generalizability of the findings is limited because data for this study were obtained from only one surgery center.

CONCLUSIONS

The study results indicate that Jackson-Pratt drain is equally effective for preventing cardiac tamponade, pleural effusions and pain intensity in patients after CABG when compared with conventional chest tubes, but was significantly superior regarding efficacy to the hospital and ICU LOS and the incidence of AF.

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Conflicts of interest

There are no conflicts of interest.

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