Incidence and risk factors of postpericardiotomy syndrome requiring medical attention: The Finland postpericardiotomy syndrome study

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Objectives: Postpericardiotomy syndrome is a well-known complication after cardiac surgery. Nevertheless, little is known about the incidence and predictors of postpericardiotomy syndrome requiring medical attention or hospitalization in a contemporary set of patients undergoing isolated coronary bypass.

Methods: This retrospective analysis included 688 patients from 2008 to 2010. The median follow-up time was 5.3 [4.5-6.0] years.

Results: The incidence of postpericardiotomy syndrome was 61 of 688 patients (8.9%), and the median time to diagnosis was 21 [11-52] days, but only 13 patients (22%) required pleural drainage and 3 patients (4.9%) required pericardiocentesis. Patients with postpericardiotomy syndrome more often had 1 or more red blood cell units transfused (61% vs 43%, $P = .008$) after surgery and less often had diabetes (12% vs 31% $P = .002$) or metformin medication (3.3% vs 20%, $P = .001$) compared with those without postpericardiotomy syndrome. In multivariable Cox regression model, renal insufficiency and 1 or more red blood cell units transfused remained as independent predictors of postpericardiotomy syndrome and diabetes remained as a protective factor. Incidence of recurrences was high (38%), and increasing body mass index was the only predictor of relapse.

Conclusions: The incidence of symptomatic postpericardiotomy syndrome leading to medical care contact was markedly lower compared with that reported in older clinical studies. Postpericardiotomy syndrome was associated with the use of red blood cell units and was less common in patients with medically treated diabetes. (J Thorac Cardiovasc Surg 2015;149:1324-9)

See related commentary pages 1330-1.

Postpericardiotomy syndrome (PPS) is a common complication after cardiac surgery. It may lead to prolonged hospital stay, readmissions, and invasive interventions including pericardial or pleural drainage, but the majority of cases have a benign course with mild fever and self-limiting pericardial and pleural effusions. In the literature, the incidence of PPS varies from 10% to 40%,¹⁻¹⁰ and differences in definitions, patient populations, and postdischarge follow-up likely explain this variability and discrepancy. Although recent randomized

clinical trials, the COLchicine for Prevention of the Postpericardiotomy Syndrome and Postoperative Atrial Fibrillation 1 and 2, reported 21% to 29% incidences of PPS at 3 to 12 months follow-up, little is known about the incidence and predictors of PPS requiring medical attention or hospitalization because of symptoms related to PPS in clinical practice.

In this retrospective “real world” study, we sought to assess the incidence and predictors of PPS requiring medical attention as defined by hospital stay prolongation, readmission, or medical therapy for its treatment.

MATERIAL AND METHODS

This study is part of a wider protocol in progress to assess thrombotic and bleeding complications of cardiac procedures in Western Finland.¹¹⁻¹³ Follow-up data were retrieved retrospectively up to 24 months from the surgery from the catchment areas of the Turku University Hospital, the Turku City Hospital, and the Satakunta Central Hospital, Finland. The overall patient population included a consecutive series of 699 patients who underwent isolated coronary artery bypass grafting (CABG) at Turku University Hospital, Finland, from 2008 to 2010. Follow-up data were complete for 688 patients. Hospital records and death certificates from the Statistics Finland were used to acquire data on the mode and date of death. The study protocol was approved by the Ethics Committees of participating hospitals.

Definition of Postpericardiotomy Syndrome and Relapse

PPS was defined by the presence of at least 2 of the following criteria: fever without alternative causes, pleuritic chest pain, friction rub, evidence of new

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Abbreviations and Acronyms

CABG	= coronary artery bypass grafting
CI	= confidence interval
HR	= hazard ratio
NSAID	= nonsteroidal anti-inflammatory drug
PPS	= postpericardiotomy syndrome

or worsening pleural effusion, and evidence of new or worsening pericardial effusion.¹⁴ Relapse was defined by worsening of pericardial or pleural effusion while on medication or after withdrawal of medication.

Diabetes was defined as diabetes requiring medical treatment, pulmonary disease was defined as a lung disease requiring long-term use of bronchodilators or steroids, and stroke was defined as a new neurologic deficit after surgery and lasting more than 24 hours accompanied by new structural changes in computed tomography or magnetic resonance imaging or otherwise verified by clinical assessment. Extracardiac arteriopathy was defined as 1 or more of the following: claudication, carotid occlusion or greater than 50% stenosis, and previous or planned intervention on the abdominal aorta, limb arteries, or carotid arteries. Recent acute myocardial infarction was defined as an acute myocardial infarction less than 3 months before CABG. Urgent operation was defined as an operation during the same in-hospital stay, and emergency operation was defined as an operation before the next working day or within a few hours after angiography. Positive x-ray was defined by new or worsening pleural effusion or new or worsening cardiac silhouette enlargement. Positive electrocardiogram was defined by widespread ST elevations. Postoperative bleeding was defined as bleeding measured in the intensive care unit on the morning of the first postoperative day. Surgical bleeding was defined as a significant bleeding from any anastomosis, graft, or vessel in the surgical field (pericardial artery, thoracic vessels, Keynes veins). The classification of “normal,” “abnormal,” and “major” use of red blood cell units, fresh-frozen plasma cell units, and platelet units was based on the classification of a wider study in which the patient population of the present study was included.¹⁵

Statistical Analysis

Statistical analysis was performed using SPSS statistical software (version 22, IBM SPSS Inc, Armonk, NY). Continuous variables were reported as the mean $\pm$ standard deviation if they were normally distributed and as median [25th, 75th percentiles] if they were skewed. Data were tested for normality assumption using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Categorical variables were described with absolute and relative (percentage) frequencies. Chi-square test, Mann-Whitney test, and Cox regression were used for univariable analysis. The Kaplan-Meier method was used to present survival curves. Multivariable analysis was performed using the Cox regression method by including variables of relevance. Variables with a *P* value less than .10 in the univariable analysis were entered in the multivariable analysis.

RESULTS

Incidence of Postpericardiotomy Syndrome

The median follow-up time was 5.3 ± 1.0 years. Altogether, 61 of 688 patients (8.9%) undergoing CABG had PPS leading to delayed hospital discharge, readmission, or medical therapy due to symptoms. The mean latency between operation and hospital admission to PPS was 21 (11-52) days [range, 3-140 days]. Freedom from PPS in patients undergoing isolated CABG is detailed in

Figure 1. Pleuritic chest pain, dyspnea, and fever occurred in 20%, 44%, and 41% of patients with PPS, respectively. Abnormal C-reactive protein values were found in 84%, abnormal erythrocyte sedimentation rate was found in 90%, pericardial effusion was found in 93%, positive chest x-ray was found in 93%, friction rub was found in 6.9%, and positive electrocardiogram was found in 45% of patients with PPS.

The baseline characteristics and operative data in patients with and without PPS are detailed in [Table 1](#). No differences in the baseline characteristics were detected except that patients with PPS significantly less often had diabetes and were less often taking metformin. Postoperative characteristics in patients with and without PPS are detailed in [Table 2](#). Red blood cell units were significantly more often transfused in the PPS group, and they had a nonsignificant trend toward more postoperative bleeding.

Pleural puncture was performed in 13 patients (22%) with PPS, and pericardiocentesis was performed in 3 patients (4.9%) with PPS. One patient had PPS leading to clinical cardiac tamponade. No differences in the mortality rates were detected.

Predictors of Postpericardiotomy Syndrome and Relapse

Cox regression univariable model identified the following variables as predictors of PPS: 1 or more red blood cell units used (hazard ratio [HR], 2.1; 95% confidence interval [CI], 1.3-3.5; *P* = .005) and abnormal use of red blood cell units (HR, 1.9; 95% CI, 1.1-3.4; *P* = .016). Diabetes (HR, 0.31; 95% CI, 0.14-0.69; *P* = .004) and metformin (HR, 0.14; 95% CI, 0.034-0.58; *P* = .006) were protective factors. The variables with a *P* value less than .10 were entered in the multivariable Cox regression analysis. Metformin was excluded because of its association with diabetes, and abnormal use of red blood cell units was excluded because of its association with the use of 1 or more red blood cell units. In multivariable analysis, 1 or more red blood cell units used (HR, 1.9; 95% CI, 1.1-3.2; *P* = .017) and decreasing estimated glomerular filtration rate using the Modification of Diet in Renal Disease formula (HR, 0.99; 95% CI, 0.98-1.0; *P* = .078) remained as independent predictors of PPS. Diabetes (HR, 0.32; 95% CI, 0.15-0.71; *P* = .005) remained an independent protective factor.

Overall, 23 of 61 patients (38%) with PPS had a relapse as defined by worsening of pericardial or pleural effusion while on medication or after withdrawal of medication. The baseline characteristics, operative data, symptoms, and clinical findings of patients with relapsed PPS versus patients with nonrelapsed PPS are detailed in [Table 3](#). Patients with relapsed PPS were more obese. The outcome events of relapsed PPS versus nonrelapsed PPS are detailed in [Table 4](#). Patients with relapsed PPS had significantly

FIGURE 1. Kaplan–Meier curve with 95% CIs periodically for the freedom from PPS in patients undergoing isolated CABG. PPS, Postpericardiotomy syndrome.

shorter in-hospital stay after the index CABG and more pleural punctures due to PPS.

Medication for Postpericardiotomy Syndrome and Relapses

First-line medication for PPS was glucocorticoids in 43% of patients, nonsteroidal anti-inflammatory drugs (NSAIDs) in 23% of patients, and colchicine in 15% of patients. First-line medications in patients with relapsed PPS and nonrelapsed PPS are detailed in Table 3. There were no significant differences in the first-line medications between relapsed PPS and nonrelapsed PPS cases.

DISCUSSION

In this “real world” study, the incidence of PPS requiring medical attention was markedly lower compared with incidences reported in recent clinical trials.^{1,3,4} Of note, the clinical course of PPS requiring medical attention was mainly benign, and pericardiocentesis or pleural drainage was performed in only 14 patients (23%) with PPS.

This study provides evidence of the association of bleeding and red blood cell use with the occurrence of PPS. Patients with 1 or more red blood cell units used more often had PPS compared with those without. Also, use of abnormal red blood cell units (1-2 units) was a predictor of PPS, but 1 or more red blood cell units used had a stronger presumption against null hypothesis. Thus, the incidence of PPS is presumably not connected to the number of red blood cell units transfused but to the overall use. Surgical trauma and operative effusions have been

TABLE 1. Baseline characteristics and operative data in patients with and without postpericardiotomy syndrome and who underwent isolated coronary artery bypass surgery

	PPS N = 61	No PPS N = 627	P value
Age (y)	67 [59, 74]	67 [60, 73]	.95
Female	13 (21%)	141 (23%)	.83
BMI	28 [25, 30]	28 [25, 31]	.32
Diabetes	7 (12%)	190 (31%)	.002
Hypertension	58 (95%)	590 (94%)	.83
Pulmonary disease	3 (4.9%)	49 (7.8%)	.41
Atrial fibrillation	3 (4.9%)	49 (7.8%)	.41
Prior stroke or transient ischemic attack	3 (4.9%)	44 (7.0%)	.54
Prior percutaneous coronary intervention	10 (16%)	110 (17%)	.92
Prior cardiac surgery	0 (0.0%)	14 (2.2%)	.24
Extracardiac arteriopathy	1 (1.6%)	50 (8.0%)	.071
Recent AMI	14 (23%)	130 (21%)	.76
2- or 3-vessel disease	57 (93%)	600 (96%)	.34
Left main stenosis	32 (53%)	280 (44%)	.20
Left ventricular ejection fraction <30%	5 (8.2%)	43 (6.9%)	.70
Emergency operation	7 (12%)	94 (15%)	.46
Urgent or emergency operation	33 (54%)	320 (51%)	.65
Preoperative IABP	2 (3.3%)	5 (0.8%)	.065
Off-pump surgery	8 (13%)	71 (11%)	.68
At least 1 thoracic artery graft	60 (98%)	600 (95%)	.28
Radial artery graft	4 (6.6%)	47 (7.5%)	.79
No. of distal anastomoses	3.0 [2.0, 3.0]	3.0 [2.0, 3.0]	.84
Preoperative laboratory results			
INR	1.0 [1.0, 1.1]	1.1 [1.0, 1.1]	.054
Hemoglobin	140 [130, 150]	140 [130, 150]	.72
Creatinine	87 [77, 100]	82 [72, 95]	.068
eGFR	70 [62, 83]	77 [65, 90]	.069
Preoperative drug treatment			
Aspirin	60 (98%)	580 (95%)	.20
Clopidogrel	14 (23%)	100 (17%)	.22
LMWH	13 (21%)	160 (27%)	.34
Warfarin	5 (8.2%)	52 (8.5%)	.93
Statin	61 (100%)	590 (95%)	.074
Glycoprotein IIa/IIIb inhibitors	2 (3.3%)	24 (3.8%)	.83
Thrombolysis	0 (0.0%)	17 (2.7%)	.19
Metformin	2 (3.3%)	130 (20%)	.001
Sulphonylurea	1 (1.6%)	47 (7.5%)	.086
Gliptin	0 (0.0%)	8 (1.3%)	.37
Glitazone	0 (0.0%)	6 (1.0%)	.44
Insulin	4 (6.6%)	85 (14%)	.12
Aortic crossclamping time (min)	61 [46, 71]	59 [47, 70]	.61
CPB time (min)	80 [71, 97]	80 [67, 94]	.80
Operation length (min)	180 [150, 220]	180 [160, 210]	.58

Continuous variables are reported as median [25th, 75th percentiles]. Values in parentheses are percentages. PPS, Postpericardiotomy syndrome; BMI, body mass index; AMI, acute myocardial infarction; IABP, intra-aortic balloon pump; INR, international normalized ratio; eGFR, estimated glomerular filtration rate (using Modification of Diet in Renal Disease formula); LMWH, low molecular weight heparin; CPB, cardiopulmonary bypass.

TABLE 2. Postoperative characteristics after coronary bypass surgery in patients with and without postpericardiotomy syndrome

	PPS N = 61	No PPS N = 627	P value
IABP	5 (8.2%)	47 (7.5%)	.85
Atrial fibrillation	11 (18%)	140 (23%)	.41
Stroke or transient ischemic attack	1 (1.6%)	29 (4.6%)	.28
Pneumonia	3 (5.7%)	19 (3.4%)	.39
Mediastinitis	1 (1.9%)	7 (1.2%)	.69
Red blood cell			
≥1 units used	37 (61%)	270 (43%)	.008
Abnormal use (1-2 units)	19 (31%)	120 (19%)	.019
Major use (>2 units)	18 (30%)	150 (24%)	.36
Fresh-frozen plasma			
≥1 units used	11 (18%)	99 (16%)	.61
Abnormal use (1-4 units)	11 (18%)	88 (14%)	.40
Major use (>4 units)	0 (0.0%)	11 (1.8%)	.30
Platelets			
≥1 units used	7 (12%)	70 (11%)	.95
Abnormal use (1-8 units)	7 (12%)	56 (8.9%)	.51
Major use (>8 units)	0 (0.0%)	14 (2.2%)	.24
Bleeding (mL)	980 [670, 1300]	830 [620, 1200]	.099
Resternotomy for bleeding	4 (6.6%)	58 (9.3%)	.48
Surgical bleeding	5 (8.2%)	25 (4.0%)	.12
ICU stay (d)	1.0 [1.0, 2.0]	1.0 [1.0, 2.0]	.89
In-hospital stay (d)	7.0 [6.0, 8.0]	7.0 [5.0, 8.0]	.36

Continuous variables are reported as median [25th, 75th percentiles]. Values in parentheses are percentages. Surgical bleeding is a significant bleeding from any anastomosis, graft, or vessel in the surgical field (pericardial artery, thoracic vessels, Keynes veins). PPS, Postpericardiotomy syndrome; IABP, intra-aortic balloon pump; ICU, intensive care unit.

suggested as potential stimuli for PPS presentation; however, such causality has not been shown.

The incidence of PPS in this study was lower compared with earlier reports (8.9% vs 10%-40%).¹⁻¹⁰ This could be partly attributed to the lack of standardized diagnostic criteria in previous studies. In the current study, however, we used the definition of PPS described in the most recent review article of the diagnostic criteria of PPS.¹⁴ In prospective studies, the diagnosing of PPS is more sensitive, because the follow-ups are mostly performed by PPS researchers. Thus, the incidence is higher, but the present study implicates that most of the diagnoses are clinically irrelevant. It may also refer to improvements in surgical and cardiopulmonary bypass techniques (eg, smaller bypass circuit and avoidance of cardiomy suckers). It might also be related to changes in blood transfusion protocols and blood conservation strategies.¹⁶

In this study, renal insufficiency was associated with PPS. Of note, diabetic patients less often had PPS compared with those without diabetes. Metformin appeared to be the protective factor, although all the other diabetes medications also had a nonsignificant trend toward lesser PPS frequency. A possible mechanism of action of metformin is its effect on

the immune system. According to previous studies, high-dose metformin potentiates lymphocyte-suppressing and systemic anti-inflammatory effects of simvastatin and fenofibrate in patients with early glucose metabolism abnormalities.^{17,18} Previously known predictors of PPS were pleural incision and female gender.¹ Direct pericardial trauma, pericardial bleeding, and individual predisposition are considered to be specific triggers for the syndrome.¹⁹ In a study released in 1988, lower age, history of prednisone treatment, blood type B–, halothane anesthesia, history of pericarditis, aortic valve replacement, lower weight, higher mean percentages of lymphocytes, and lower platelet counts were predictors of PPS, but the diagnostic criteria were significantly different.⁵ Diabetes was not included in the preoperative data, and the amount of perioperative transfusions did not reach statistical significance.

The incidence of relapses was high (38%). In previous studies, recurrences have been reported in approximately 30% of patients.^{20,21} On the basis of clinical experience and observational reports, aspirin and other NSAIDs are the first-line approach,^{22,23} although the effect of NSAIDs in reducing postoperative pericardial effusion volume is not clear.²⁴ The use of NSAIDs was relatively low (23%), and the most frequently used first-line medication was glucocorticoids. The high incidence of relapse could be related to the frequent use of glucocorticoids, because according to the latest studies the risk of recurrences of pericarditis is increased by steroid use.^{20,21} In the present study, none of the first-line medications were significantly related to relapse. However, increasing body mass index was a predictor of relapse. In-hospital length of stay after surgery was also significantly shorter, and more pleural punctures due to PPS were performed in the relapsed PPS study group than in the nonrelapsed PPS study group.

The cause of PPS has remained partially unclear. The syndrome has been assumed to be an immune-mediated process, but the role of perioperative infections is unknown²⁵ and the participation of immune system is not unequivocal because the syndrome has been present in patients with immunosuppression.²⁶ The present study screened preoperative, perioperative, and postoperative factors associated with PPS that could possibly clarify the cause of the syndrome. According to previous studies, preoperative colchicine can significantly decrease the appearance of the syndrome,^{3,4,21} although in the recently published Post-Operative Pericardial Effusion 2 study, colchicine was no better than placebo at reducing the effusion and the risk of cardiac tamponade. A possible clinical implication of the present study is to use preoperative colchicine in patients with predictive factors of PPS. The possible side effects of colchicine thus could be reduced and the number needed to treat consequently lowered. Another possible clinical implication is the use of more aggressive first-line medication for patients with predictors

TABLE 3. Baseline characteristics and operative data in patients with relapsed postpericardiotomy syndrome and nonrelapsed postpericardiotomy syndrome

	Relapsed PPS N = 23	Nonrelapsed PPS N = 38	P value
Age (y)	70 [61, 74]	66 [58, 73]	.92
Female	3 (13%)	10 (26%)	.22
BMI	29 [27, 32]	26 [25, 30]	.024
Diabetes	3 (13%)	4 (11%)	.77
Hypertension	22 (96%)	36 (95%)	.87
Pulmonary disease	0 (0.0%)	3 (7.9%)	.17
Atrial fibrillation	2 (8.7%)	1 (2.6%)	.29
Prior stroke or transient ischemic attack	1 (4.3%)	2 (5.3%)	.87
Prior percutaneous coronary intervention	5 (22%)	5 (13%)	.38
Prior cardiac surgery	0 (0.0%)	0 (0.0%)	—
Extracardiac arteriopathy	1 (4.3%)	0 (0.0%)	.20
Recent AMI	7 (30%)	7 (18%)	.28
2- or 3-vessel disease	21 (91%)	36 (95%)	.60
Left main stenosis	14 (61%)	18 (47%)	.31
Left ventricular ejection fraction <30%	3 (13%)	2 (5.3%)	.28
Emergency operation	5 (22%)	2 (5.3%)	.050
Urgent or emergency operation	16 (70%)	17 (45%)	.059
Preoperative IABP	2 (8.7%)	0 (0.0%)	.065
Off-pump surgery	4 (17%)	4 (11%)	.44
At least 1 thoracic artery graft	23 (100%)	37 (97%)	.43
Radial artery graft	1 (4.3%)	3 (7.9%)	.59
No. of distal anastomoses	2.0 [2.0, 3.0]	3.0 [2.0, 3.0]	.22
Preoperative laboratory results			
INR	1.0 [1.0, 1.1]	1.0 [1.0, 1.1]	.49
Hemoglobin	140 [130, 150]	140 [130, 150]	.72
Creatinine	91 [84, 99]	84 [73, 100]	.27
eGFR	70 [64, 78]	73 [60, 87]	.63
Preoperative drug treatment			
Aspirin	23 (100%)	37 (97%)	.43
Clopidogrel	6 (26%)	8 (21%)	.65
LMWH	6 (26%)	7 (18%)	.48
Warfarin	3 (13%)	2 (5.3%)	.28
Statin	23 (100%)	38 (100%)	—
Glycoprotein IIa/IIIb inhibitors	0 (0.0%)	2 (5.3%)	.26
Thrombolysis	0 (0.0%)	0 (0.0%)	—
Metformin	2 (8.7%)	0 (0.0%)	.065
Sulphonylurea	1 (4.3%)	0 (0.0%)	.20
Gliptin	0 (0.0%)	0 (0.0%)	—
Glitazone	0 (0.0%)	0 (0.0%)	—
Insulin	1 (4.3%)	3 (7.9%)	.59
Aortic crossclamping time (min)	52 [43, 71]	62 [55, 71]	.25
CPB time (min)	74 [60, 99]	85 [73, 94]	.32
Operation length (min)	170 [140, 210]	180 [170, 220]	.22
PPS symptoms			
Pleuritic chest pain	6 (26%)	6 (16%)	.33
Dyspnea	12 (52%)	15 (40%)	.33
Fever	11 (48%)	14 (37%)	.40

(Continued)

TABLE 3. Continued

	Relapsed PPS N = 23	Nonrelapsed PPS N = 38	P value
PPS findings			
Elevated CRP levels	19 (83%)	32 (84%)	.87
Elevated ESR levels	7 (100%)	13 (87%)	.31
Echocardiography	21 (96%)	32 (91%)	.56
Positive chest x-ray	22 (96%)	32 (91%)	.54
x-ray: pleural effusion	19 (83%)	28 (76%)	.53
x-ray: pericardial effusion	11 (48%)	16 (43%)	.73
Friction rub	1 (4.5%)	3 (8.3%)	.58
Positive ECG	9 (47%)	13 (43%)	.78
First-line PPS medication			
Starting latency (d)	1.0 [0.0, 4.0]	0.0 [0.0, 4.3]	.52
NSAID	8 (35%)	6 (16%)	.087
Glucocorticoids	12 (52%)	14 (37%)	.24
Colchicine	2 (8.7%)	7 (18%)	.30

Continuous variables are reported as median [25th, 75th percentiles]. Values in parentheses are percentages. *PPS*, Postpericardiotomy syndrome; *BMI*, body mass index; *AMI*, acute myocardial infarction; *IABP*, intra-aortic balloon pump; *INR*, international normalized ratio; *eGFR*, estimated glomerular filtration rate (using the Modification of Diet in Renal Disease formula); *LMWH*, low molecular weight heparin; *CPB*, cardiopulmonary bypass; *CRP*, C-reactive protein; *ESR*, erythrocyte sedimentation rate; *ECG*, electrocardiography; *NSAID*, nonsteroidal anti-inflammatory drug.

of relapse. For example, colchicine could be used as first-line medication instead of NSAID in patients with a high risk of relapse.

Study Limitations

The retrospective nature of this study is a limitation. On the other hand, follow-up was complete for as much as 98% of the patients because treatment of patients belonging to the catchment area of our institution is mainly centralized. This allowed us to obtain information on major clinical events requiring hospital treatment and information on outpatient visits after surgery because they were performed almost exclusively in tertiary health care. Data on late mortality were obtained from the Statistics Finland, which ensures the quality of survival data of these patients. The small size of this study is another limitation of this analysis; therefore, these findings should be viewed as hypothesis generating. Also, all tests leading to the diagnosis of PPS (eg, chest x-ray and echocardiography) were not performed in every patient, so the underdiagnosing of asymptomatic PPS is conceivable. Nevertheless, the tests were performed as clinically indicated, which reflects the “real world” feature of the present study.

CONCLUSIONS

The present results suggest that PPS is associated with the use of red blood cell units and is less common in patients with medically treated diabetes. The incidence of PPS was lower and the incidence of relapse was higher when compared with the previous studies.

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TABLE 4. Outcome after coronary bypass surgery in patients with relapsed postpericardiotomy syndrome and nonrelapsed postpericardiotomy syndrome

	Relapsed PPS N = 23	Nonrelapsed PPS N = 38	P value
IABP	2 (8.7%)	3 (7.9%)	.91
Atrial fibrillation	5 (22%)	6 (16%)	.56
Stroke or transient ischemic attack	1 (4.3%)	0 (0.0%)	.20
Pneumonia	1 (4.8%)	2 (6.3%)	.82
Mediastinitis	0 (0.0%)	1 (3.1%)	.41
Red blood cell			
≥1 units used	14 (61%)	23 (61%)	.98
Abnormal use (1-2 units)	6 (26%)	13 (34%)	.51
Major use (>2 units)	8 (35%)	10 (26%)	.48
Fresh-frozen plasma			
≥1 units used	4 (17%)	7 (18%)	.88
Abnormal use (1-4 units)	4 (17%)	7 (18%)	.92
Major use (>4 units)	0 (0.0%)	0 (0.0%)	—
Platelets			
≥1 units used	2 (8.7%)	5 (13%)	.60
Abnormal use (1-8 units)	2 (8.7%)	5 (13%)	.60
Major use (>8 units)	0 (0.0%)	0 (0.0%)	—
Bleeding (mL)	990 [580, 1500]	980 [690, 1300]	.48
Resternotomy for bleeding	0 (0.0%)	4 (11%)	.11
Surgical bleeding	0 (0.0%)	5 (13%)	.069
ICU stay (d)	1.0 [1.0, 2.0]	1.0 [1.0, 2.0]	.72
In-hospital stay (d)	7.0 [6.0, 8.0]	8.0 [7.0, 9.0]	.017
Days from operation to hospital admission	34 [13, 57]	15 [10, 51]	.094
Pleural puncture due to PPS	9 (39%)	4 (11%)	.010
Pericardiocentesis	2 (8.7%)	1 (2.6%)	.29

Continuous variables are reported as median [25th, 75th percentiles]. Values in parentheses are percentages. Surgical bleeding is a significant bleeding from any anastomosis, graft, or vessel in the surgical field (pericardial artery, thoracic vessels, Keynes veins). PPS, Postpericardiotomy syndrome; IABP, intra-aortic balloon pump; ICU, intensive care unit.

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