Costs Associated With Complications of Retained Blood in Cardiac Surgery

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Introduction

Patients who bleed after cardiac surgery require chest tubes to evacuate blood around the heart and lungs during early recovery. Chest tubes can become obstructed with clot, leading to a retained blood syndrome (RBS) that requires reinterventions to remove blood and bloody fluids in the form of pericardial tamponade, pericardial effusions, hemothorax and pleural effusions. Current information about the economic burden of RBS is limited.

Objectives

This research was designed to determine the hospital costs associated with RBS during the initial index hospitalization after cardiac surgery.

Methods

Single center, observational analysis at a university hospital in Germany. All patients undergoing cardiac surgery in four consecutive years with pericardial or pleural drains were included. Retained blood syndrome (RBS) was defined as pleural and pericardial effusion, tamponade and/or hemothorax requiring thoracentesis or re-exploration. Differences between groups were analyzed with the Mann-Whitney-U-test. Multivariate, robust regression with Huber function was applied to adjust for confounders influencing total costs in Euro. $P < 0.05$ was considered statistically significant.

Results

Data from 3.184 patients was included in analysis. RBS was found in 17% of all respective cases. Basic patient characteristics, surgery related data, pre-existing medical conditions and outcome criteria are presented in Table 1. Median of total costs was 35,264 [22,246;67,690] Euros in patients with RBS compared to 14,888 [11,870;20,776] Euros in the control group (see Fig. 1). Mean difference regarding actual length of stay and assumed length of stay of the respective DRG case are visualized in Figure 2. Adjusted for confounding factors, the incremental increase due to RBS was 15,278.38 Euros (95% CI: 14,001-16,556; p<0.001), Table 2.

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	[ALL] N=3184 (100%)	No RBS N=2654 (83%)	RBS N=530 (17%)	p
Basic data				
Age [y]	69.0 [61.0;75.0]	69.0 [61.0;74.0]	71.0 [64.0;76.0]	<0.001
Sex: F	889 (27.9%)	710 (26.8%)	179 (33.8%)	0.001
Body Mass Index (BMI)	26.8 [24.3;30.2]	26.9 [24.2;30.3]	26.3 [24.1;29.7]	0.062
Surgery				
Type of surgery:				<0.001
CABG	1812 (56.9%)	1588 (59.8%)	224 (42.3%)	
Valves	984 (30.9%)	769 (29.0%)	215 (40.6%)	
Both	388 (12.2%)	297 (11.2%)	91 (17.2%)	
Duration of surgery [m]	200 [165;250]	200 [165;245]	210 [170;260]	0.022
Priority of surgery:				0.009
elective	1894 (77.4%)	1586 (78.3%)	308 (73.0%)	
urgent	241 (9.84%)	200 (9.87%)	41 (9.72%)	
emergency	313 (12.8%)	240 (11.8%)	73 (17.3%)	
RBC transfusion (pat. %)	774 (25.2%)	589 (23.0%)	185 (36.8%)	<0.001
RBC transfusion [units]	1.96 (1.06)	1.88 (0.98)	2.18 (1.25)	0.003
ACEF score	1.28 [1.13;1.60]	1.27 [1.12;1.54]	1.40 [1.21;1.90]	<0.001
APACHE II	18.0 [14.0;25.0]	18.0 [13.0;24.0]	20.0 [15.0;26.0]	<0.001
Pre-existing medical conditions				
Coronary heart disease	2488 (78.1%)	2098 (79.1%)	390 (73.6%)	0.006
Left heart failure (>NYHA II)	1349 (42.4%)	1049 (39.5%)	300 (56.6%)	<0.001
COPD	598 (18.8%)	483 (18.2%)	115 (21.7%)	0.068
Endocrine disease	2897 (91.0%)	2390 (90.1%)	507 (95.7%)	<0.001
Peripheral vascular disease	691 (21.7%)	541 (20.4%)	150 (28.3%)	<0.001
Atrial fibrillation	1215 (38.2%)	899 (33.9%)	316 (59.6%)	<0.001
Creatinine pre-op >1.7 mg/dl	303 (9.79%)	210 (8.12%)	93 (18.3%)	<0.001
Haematocrit pre op	41.0 [37.0;43.0]	41.0 [38.0;44.0]	39.0 [35.0;43.0]	<0.001
Haemostatic disorder	344 (10.8%)	280 (10.6%)	64 (12.1%)	0.339
Antiaggregation				0.295
Mono antiplatelet therapy	1127 (47.5%)	967 (47.8%)	160 (45.5%)	
Dual antiplatelet therapy	548 (23.1%)	472 (23.3%)	76 (21.6%)	
Outcome				
Mortality (In-hospital)	195 (6.12%)	118 (4.45%)	77 (14.5%)	<0.001
Mortality (1 year)	398 (15.3%)	257 (11.9%)	141 (32.5%)	<0.001
LOS (Hospital) [d]	13.0 [9.00;21.0]	12.0 [8.00;17.0]	26.0 [16.0;46.0]	<0.001
LOS (ICU) [d]	6.00 [4.00;10.0]	5.00 [4.00;8.00]	16.0 [8.00;33.0]	<0.001
Time of ventilation [h]	33.0 [17.0;72.0]	30.0 [15.0;58.0]	105 [38.0;380]	<0.001
Incidence of hemodialysis	549 (17.2%)	335 (12.6%)	214 (40.4%)	<0.001
pRBC post-op [units]	677 (21.3%)	382 (14.4%)	295 (55.7%)	<0.001
Total cost per case [Euro]	16210 [12356;25522]	14888 [11870;20776]	35264 [22246;67690]	<0.001
Difference between DRG-LOS and actual LOS [days]	-2.80 [-6.20;1.50]	-3.00 [-6.10;0.50]	-0.10 [-7.37;10.6]	<0.001

Table 1: Descriptive statistics on patient characteristics and outcome

Conclusions

Awareness about the costs of complications is crucial as the costs of care come under increasing scrutiny. In this study, we demonstrate that hospital expenses are strongly associated with the occurrence of RBS. Further studies are indicated to determine if the increase in incremental costs extends after discharge as well. Developing methods and protocols to reduce RBS may result in substantial cost-of-care savings.

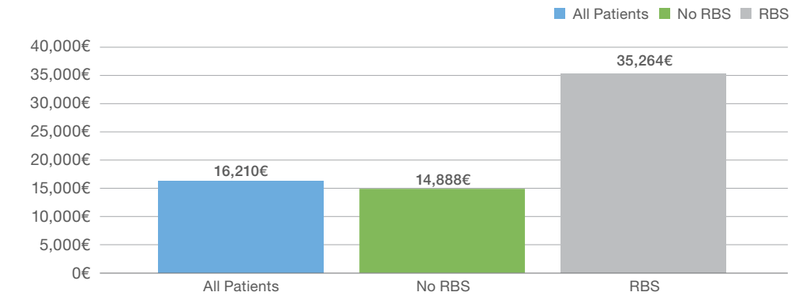

Figure 1: Median of total case cost [€]

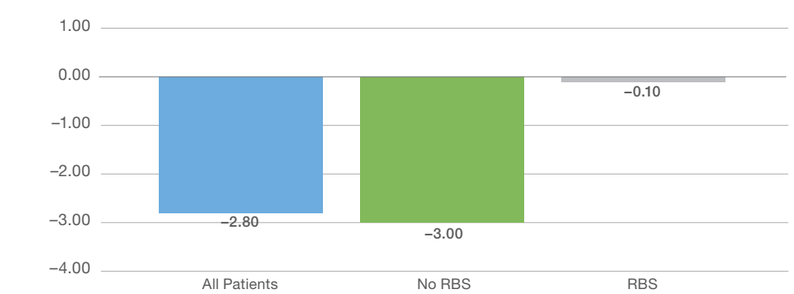

Figure 2: Median of DRG-assumed and actual length of stay [d]

	Estimate (€)	p	95% CI	
Intercept	**5.512**	**0.005**	**1.695**	**- 9.330**
Left heart failure (> NYHA II)	1.874	< 0.001	1.023	- 2.725
COPD	1.366	0.011	309	- 2.423
Endocrine disease	1.549	0.031	145	- 2.954
Atrial fibrillation	4.427	< 0.001	3.518	- 5.337
Creatinine pre-op >1.7 mg/dl	6.172	< 0.001	4.636	- 7.7070
Emergency surgery	2.139	< 0.001	1.008	- 3.270
Type of surgery: Valves	1.860	0.019	312	- 3.407
Type of surgery: CABG+valves	2.524	< 0.001	1.145	- 3.904
Time on CPB [m]	66	< 0.001	56	- 76
pRBC intra-op [unit]	1.550	< 0.001	1.090	- 2.010
Retained Blood Syndrome (RBS)	**15.278**	**< 0.001**	**14.001**	**- 16.556**

Table 2: Multivariate robust regression on incremental case cost