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Meeting abstract

2006 Effects of off-pump versus on-pump coronary artery bypass grafting on early and late right ventricular function

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Background

Off pump coronary artery bypass grafting (OPCABG) results in better preservation of left ventricular function in the peri-operative period than conventional on-pump coronary artery bypass grafting (ONCABG). However there is conflicting evidence as to the effect of OPCABG and ONCABG on right ventricular (RV) function, possibly because of the complexity in measuring this. cardiac magnetic resonance (CMR) is rapidly becoming established as the gold standard for the assessment of right and left ventricular function.

Methods

In a single-centre randomized trial, 60 patients with normal left ventricular function undergoing coronary artery bypass grafting (CABG) were randomly assigned to OPCABG or ONCABG. Patients underwent CMR for the assessment of RV function pre-operatively, early post-operatively and at 6 months. All CMR examinations were performed using a 1.5 Tesla MR scanner (Sonata, Siemens Medical Solutions, Erlangen, Germany), using prospective electrocardiographic gating. After localisers, steady-state free precession cine images (TE/TR 1.5/3.0 ms, flip angle 60°) were acquired in the short axis plane parallel to the AV groove (slice thickness 7 mm, inter-slice gap 3 mm) covering the entire left and right ventricle. RV function was analysed using Argus software by a single experienced cardiologist blinded to the surgical randomisation and scan order.

Results

Fifty one patients completed the first two scans, and 47 patients completed all three scans. Pre-operative characteristics and RV function did not differ significantly between the two groups, mean ± SD RV stroke volume index: OPCABG 49 ± 9 $ml.m^{-2}$, ONCABG 50 ± 15 $ml.m^{-2}$, p = 0.7. After surgery RV stroke volume index fell to 36 ± 7 $ml.m^{-2}$ in the OPCABG group and 40 ± 12 $ml.m^{-2}$ in the ONCABG group, but this did not differ significantly between the two groups, p = 0.2. This effect was predominantly due to a fall in RV end-diastolic volume index (RVEDVI) in both groups, with a relative reduction of 27% in the OPCABG group and 20% in the ONCABG group, again without significant inter-group difference (p = 0.2). In contrast to RVEDVI, RV end-systolic volume index (RVESVI) remained constant in both surgical cohorts at all the three time points. All markers of RV function recovered to pre-operative levels by 6 months, with no long term difference between the surgical techniques. Multivariate analysis of pre-operative factors likely to predict early RV ejection fraction (EF) indicated that only pre-operative RVEF and LVEF predicted outcome. Body mass index, gender, age pre-operative coronary artery anatomy or circumflex/right coronary artery grafting did not predict RV function following surgery. See Figure 1 and Tables 1 and 2.

Conclusion

Right ventricular function is impaired early after surgery but recovers by six months. The changes were similar in

Table 1: Right ventricular functional parameters following coronary artery bypass surgery.

Variable	Group	Pre-operatively	Post 6 days	Post 6 months	p value within group	p value between group
RVSVI (ml.m^{-2})	*OPCABG*	49 ± 10	36 ± 7	46 ± 8	< 0.001	0.41
	ONCABG	49 ± 16	39 ± 11	51 ± 14	< 0.001	
RVEF (%)	*OPCABG*	66 ± 6	59 ± 7	65 ± 8	< 0.001	0.46
	ONCABG	65 ± 8	61 ± 9	65 ± 7	0.03	
RVEDVI (ml.m^{-2})	*OPCABG*	74 ± 12	62 ± 9	72 ± 14	< 0.001	0.75
	ONCABG	75 ± 20	64 ± 16	76 ± 14	< 0.001	
RVESVI (ml.m^{-2})	*OPCABG*	25 ± 6	26 ± 6	26 ± 9	0.81	0.7
	ONCABG	26 ± 7	25 ± 8	26 ± 7	0.65	
Heart rate (bpm)	*OPCABG*	62 ± 8	75 ± 12	64 ± 11		
	ONCABG	60 ± 12	73 ± 15	65 ± 17		

Results are presented as mean ± SD. Within group comparisons are made with one-way ANOVA, and between group comparisons are made with repeated measures ANOVA with post Hoc correction. RVEDVI, right ventricular end diastolic volume index (ml.m^{-2}); RVEF, right ventricular ejection fraction (%); RVESVI, right ventricular end systolic volume index (ml.m^{-2}); RVSVI, right ventricular stroke volume index (ml.m^{-2});bpm, beats per minute.

both the OPCABG and ONCABG groups. This effect was produced by changes in RVEDVI, the precise mechanism for which remains unclear, but which may relate to pericardial fluid, inflammation or haematoma altering the filling conditions of the right ventricle. Our results indicate that the right ventricle is significantly impaired as a result of the general trauma of surgery, but this is not compounded by aortic cross clamp or cardiopulmonary bypass.

Table 2: Multi-variate model examining predictors of post-operative right ventricular ejection fraction.

	Full model co-efficient B value (SE)	p value	Reduced model co-efficient (B)	p value
Age	-0.10 (0.12)	0.40		
Gender	-0.19 (3.41)	0.96		
Body Mass Index	0.04 (0.36)	0.92		
RCA > 90% stenosis	-1.51 (2.42)	0.54		
Pre-operative LVEF	0.17 (0.10)	0.1	0.30 (0.11)	0.01
Pre-operative RVEF	0.52 (0.17)	0.003	0.62 (0.18)	0.001
Surgery type	3.47 (2.07)	0.1		
RCA grafted	0.73 (2.16)	0.97		
Circumflex grafted	-1.49 (3.13)	0.64		

R^2 = 0.371 Adjusted R^2 = 0.344 (for the full model co-efficient). RVEF, right ventricular ejection fraction; LVEF, left ventricular ejection fraction; RCA, right coronary artery.

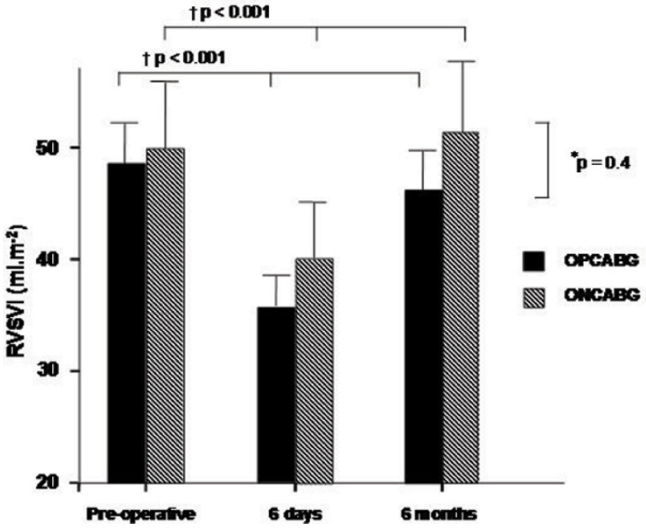

Figure 1
Mean right ventricular stroke volume index (RVSU) and 95% confidence intervals measure preoperatively, at 6 days post-operatively and at 6 months. *Denotes result using ANOVA for repeated measures with Post Hoc analysis to make overall comparisons between the 2 surgical techniques. † denotes one way ANOVA used to make within group comparisons, indicating a significant effect of surgery (both types) on early right ventricular function. OPCABG, off-pump coronary artery bypass; ONCABG, on-pump coronary artery bypass surgery.