Does number of grafts matter? Long term survival and freedom from re-intervention is not different between off-pump and on-pump coronary artery bypass grafting.

Objective

The long term effects of off-pump coronary artery bypass grafting (CABG) are the subject of speculation. Critics cite concerns about the number and technical quality of grafts performed. Our institution has over 15 years of experience performing CABG both off-pump (OPCAB) and on cardiopulmonary bypass (CPB). Our null hypothesis was that there would be no difference in a long-term composite of death and revascularisation between the two methods.

Methods

We performed a retrospective cohort study of all isolated CABG at our institution from 2001 - 2015. We used an intention to treat analysis (i.e. conversions classified as OPCAB) and performed univariate analyses of demographic factors to identify confounders. Primary outcome measures were long-term freedom from death and re-intervention. Secondary outcome measures included choice of conduit, number of grafts, training, cardiac enzyme rise, in-hospital mortality & morbidity and hospital stay.

Results

13220 patients had OPCAB (n=5858, 1.3% converted) or CPB; median followup 6.2 years. OPCAB had higher EuroSCORE (5.2±7.2 v 4.7±6.2, p=0.0001), fewer grafts (3.0±0.9 v 3.3±0.9, p<0.0001) but more total arterial grafting (46.1% v 9.4%, p<0.0001). Off pump CABG also had more trainee 1st operators (15.3% v 12.4%) and lower mortality, cardiac enzyme rise, hospital stay and complications. There was no difference in longterm survival (Log rank p=0.95) or freedom from death and re-intervention (p=0.49).

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Conclusion

Off-pump coronary artery bypass grafting is performed with good short and long term outcomes in our institution. Our low conversion rate, despite training, demonstrates that this technique can offer the same longevity as the traditional standard of CABG performed on cardiopulmonary bypass. The number of grafts performed is clinically comparable, if statistically different, and appears to provide equal benefits to survival and freedom from re-intervention as on-pump CABG.

Demographic data

		OPCAB n=5858	CPB n=7362	p-value
Male	***n (%)***	**4701 (80.3)**	**6011 (81.6)**	**0.04***
White British	***n (%)***	**5544 (97.3)**	**6947 (96.3)**	**0.54**
Age	***mean ± SD***	**65.9 ± 9.6**	**66.3 ± 9.2**	**0.01***
BMI	***mean ± SD***	**28.7 ± 4.6**	**28.8 ± 4.6**	**0.33**
Creatinine	***mean ± SD***	**99.2 ± 54.2**	**95.3 ± 41.3**	**<0.0001***
Renal Impairment				**0.0014***
ARF	***n (%)***	**23 (0.4)**	**28 (0.4)**	
CRF	***n (%)***	**386 (6.7)**	**633 (8.5)**	
Ejection Fraction				**0.0007***
Moderate	***n (%)***	**1701 (29.4)**	**2137 (28.7)**	
Poor	***n (%)***	**542 (9.4)**	**569 (7.6)**	
Very poor	***n (%)***	**21 (0.4)**	**17 (0.2)**	
Sinus Rhythm	***n (%)***	**5519 (95.4)**	**7090 (95.5)**	**0.83**
NYHA class				**<0.0001***
III	***n (%)***	**1403 (24.2)**	**1405 (18.9)**	
IV	***n (%)***	**69 (1.2)**	**110 (1.5)**	
CCS class IV	***n (%)***	**1360 (23.5)**	**1568 (21.1)**	**<0.0001***
Unstable angina	***n (%)***	**1715 (29.6)**	**1829 (24.6)**	**<0.0001***
COPD	***n (%)***	**323 (7.6)**	**380 (7.3)**	**0.58**
Neuro dysfunction	***n (%)***	**119 (16.1)**	**125 (12.7)**	**0.045***
CVA	***n (%)***	**272 (14.0)**	**274 (10.8)**	**0.0052***
Diabetes				**0.10**
Tablets	***n (%)***	**787 (13.6)**	**1057 (14.2)**	
Insulin	***n (%)***	**409 (7.1)**	**455 (6.1)**	
Extent of disease				**<0.0001***
1 vessel	***n (%)***	**319 (5.5)**	**128 (1.7)**	
2 vessel	***n (%)***	**1399 (23.9)**	**1274 (17.3)**	
3 vessel	***n (%)***	**4115 (70.3)**	**5896 (80.1)**	
IV Nitrates pre-op	***n (%)***	**314 (5.5)**	**221 (3.0)**	**<0.0001***

Inotropes pre-op	***n (%)***	**84 (1.6)**	**381 (5.9)**	**<0.0001***
Left main stem	***n (%)***	**1503 (25.5)**	**1867 (25.5)**	**0.99**
Previous MI	***n (%)***	**3143 (54.3)**	**3792 (51.3)**	**<0.0001***
Recent MI	***n (%)***	**1302 (22.5)**	**1468 (19.8)**	**<0.0001***
Urgency				**0.0003***
Urgent	***n (%)***	**1660 (28.7)**	**1994 (26.8)**	
Emergent	***n (%)***	**61 (1.1)**	**78 (1.1)**	
EuroSCORE	***mean±SD***	**5.2 ± 7.2**	**4.7 ± 6.2**	**0.0001***
	medn (IQR)	**2.8 (1.5 – 5.5)**	**2.7 (1.5 – 5.2)**	**0.052**

Intra-operative data

		OPCAB n=5858	**CPB n=7362**	**p-value**
Conversions	*n (%)*	76 (1.3)	n/a	
CPB time	*mean ± SD*	79.7 ± 40.5	105.7 ± 37.1	<0.0001*
AXC time	*mean ± SD*	28.4 ± 33.5	67.6 ± 23.0	<0.0001*
Training	*mean ± SD*	894 (15.3)	913 (12.4)	<0.0001*
No. grafts	*mean±SD*	3.0 ± 0.9	3.3 ± 0.9	<0.0001*
	medn (IQR)	3 (3 – 4)	3 (3 – 4)	<0.0001*
LIMA use	*n (%)*	5559 (94.9)	6593 (89.6)	<0.0001*
Free LIMA use	*n (%)*	27 (0.5)	53 (0.7)	0.07
RIMA use	*n (%)*	215 (3.7)	208 (2.8)	0.0072*
Radial use	*n (%)*	2677 (45.7)	917 (12.5)	<0.0001*
SVG use	*n (%)*	3161 (53.9)	6672 (90.6)	<0.0001*
Endarterectomies	*n (%)*	33 (0.6)	443 (6.0)	<0.0001*
Sequentials	*n (%)*	0.4 ± 0.7	0.2 ± 0.4	<0.0001*

Post-operative data

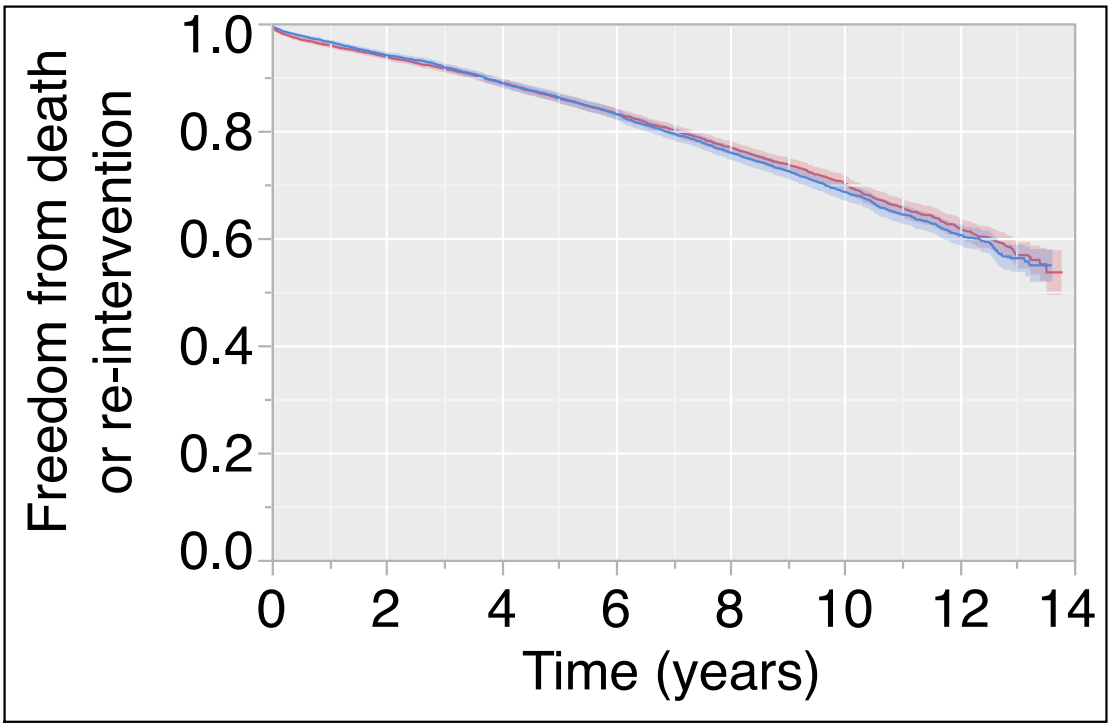
		OPCAB n=5858	CPB n=7362	p-value
Inotrope use				<0.0001*
None	n (%)	4758 (82.1)	4921 (67.5)	
1 day	n (%)	136 (2.4)	381 (5.2)	
2 days	n (%)	211 (3.6)	45 (6.1)	
Cell saver use	n (%)	733 (13.1)	540 (7.5)	<0.0001*
Reintubation rate	n(%)	219 (3.9)	235 (3.4)	0.11
Ventilator time/hr	medn (IQR)	8 (5 – 12)	9 (6 – 13)	<0.0001*
Blood loss	medn (IQR)	650 (420-970)	720 (490-1000)	<0.0001*
CKMB	mean ± SD	14.1 ± 34.9	31.7 ± 44.6	<0.0001*
Complications	n (%)	2451 (43.3)	3351 (47.8)	<0.0001*
MI	n (%)	47 (0.8)	106 (1.4)	0.0007*
DSWI	n (%)	7 (0.1)	5 (0.1)	0.27
Renal	n (%)	303 (5.2)	422 (5.7)	0.0008*
Paraplegia	n (%)	3 (0.1)	8 (0.1)	0.38
Mortality	n (%)	103 (1.8)	154 (2.1)	0.18
CVA	n (%)	15 (0.3%)	27 (0.4%)	0.45
Length of stay	mean ± SD	11.7 ± 10.1	12.4 ± 11.1	0.0006*
	median(IQR)	8.2 (7.0-12.4)	9.0 (7.1-13.4)	
Follow up/yr	mean ± SD	6.3 ± 3.9y		
	median(IQR)	6.2 (2.8 – 9.6)		
Reinterventions	n(%)	212 (3.6)	202 (2.7)	0.0041*
PCI	n(%)	174 (3.0)	154 (2.1)	0.0013*

Survival

CPB
OPCAB

Shading represents 95% CI
Log-rank p=0.96

Freedom from death or re-intervention



CPB
OPCAB

Shading represents 95% CI
Log-rank p=0.49