ARTICLE

Does obesity affect outcomes of patients undergoing coronary artery bypass surgery?

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Obesity, derived from the Latin *obesus* meaning "fattened by eating", is a state of excess body fat contributing to co-morbidity. It is a growing global epidemic, especially in the developed countries.[1] In New Zealand, obesity affects at least 17% of the population, and results in the loss of 4.7% total years of life.[2] Obesity is commonly defined as individuals having a body mass index (BMI) >30 kg/m^2, and extremely obese as having a BMI >40 kg/m^2.[3]

Obesity has long been identified as an independent risk factor for atherosclerotic coronary artery disease.[4] In addition, obesity also predisposes to hypertension, hyperlipidaemia and type II diabetes mellitus, all of which further increase the risk of ischaemic heart disease in obese individuals.[5] Thus surgical procedures, notably coronary artery bypass grafting (CABG), are often required to treat their severe coronary heart disease.

Common perceptions about obese patients and poor CABG outcomes

Obesity has been widely assumed, particularly by clinicians, to predispose patients to adverse outcomes during and after CABG.[6 7] As a result, obese patients, especially severely obese, are often declined the opportunity of undergo CABG.[8] This commonly held perception is contributed by multiple factors.

Firstly, obesity is often reported to pose additional technical challenges during surgical procedures. Such complications include difficult airway and anesthetic management, special positioning of the patient and the need for dual bypass pump oxygenators.[9]

Secondly, obese patients have been well documented by studies of other major surgical procedures as having increased incidence of many post-operative complications. These include atelectasis,[10] pneumonia,[10] deep vein thrombosis,[11 12] pulmonary embolism[11 12] and wound infections.[13] Such increased incidences have been related to pulmonary functional abnormalities,[8] accelerated coagulation,[9] decreased fibrinolytic activity,[10] as well as impaired immunity and healing[12] as a result of obesity and its strongly associated type II diabetes mellitus.

In addition, obesity, with its strongly associated hyperlipidaemia and hyperglycaemia, significantly increases risk of atherosclerosis.[5] Therefore, it is commonly believed that the vein-grafts of obese patients are more susceptible to late stenosis and eventual graft failure.[7] Indeed, obesity has been identified by the American College of Cardiology / American Heart Association guidelines for CABG as a predictor for recurrence of angina and myocardial infarction after CABG.[7] However, the group did not provide any comprehensive clinical evidence upon which their prediction was based, nor did it state whether poorer long-term survival would result.

Does clinical evidence support this common assumption about obesity?

Studies assessing the effects of obesity on CABG outcomes are either retrospective or prospective observational studies. Increased incidence of wound complications such as sternal dishiscence[14] and wound infections[8 15-20] have been consistently detected in obese patients (Table 1). Increased length of post-operative hospital stay has also been noted, and is explained as reflecting the increased efforts needed to ambulate obese patients after CABG.[8 16 19] Higher risk of post-operative arrhythmias in obese patients has also been reported.[8 18 19]

In recent large-series studies, however, obesity was not found to be associated with higher risk of myocardial infarction, stroke or pulmonary complications.[8 17 18 21] Risk of operative mortality of obese patients is also similar to that of non-obese.[14-16 19 20 22] These results contrast with earlier studies[19 20] as well as the results of Prabhakar et al,[16] as all of these associated obesity with adverse short-term outcomes. While the earlier studies were limited by

Table 1: Survey of various publications studying obesity and short-term CABG outcomesa

	Kim et al[15] (2003)	Gurm et al[21] (2002)	Kuduvalli et al[8] (2002)	Prabhakar et al[16] (2002)	Schwann et al[17] (2001)	Birkmeyer et al[14] (1998)	Moulton et al[18] (1996)	Fasol et al[19] (1992)	Prasad et al[20] (1991)
No. of patients	6728	1526	4713	559,004	3560	11,101	2299	502	500
Confounding factors adjusted	yes	yes	yes	yes	yes	yes	yes	no	no
Operative mortality	=	=	=	▲	=	=	=	=	▲
Pulmonary complications							=		▲
Arrhythmias			▲				▲	▲	
Wound infection	▲		▲	▲	▲		▲	▲	▲
Sternal dehiscence						▲			
Stroke		=	=	=	=				
Myocardial infarction		=	=		=				▲
Length of stay			▲	▲	=		▼	▲	
Reexploration	▼		=			▼		▲	
Renal failure			=	▲					

a ▲ increased risk in obese patients; ▼ decreased incidence in obese patients; = no difference between obese and non-obese

small sample sizes and failure to adjust for potential confounding factors,[19 20] the results of Prabhakar and colleagues were significant, particularly because of the large sample size.[16] By including 559,004 patients in their study, Prabhakar et al reported that extremely obese patients had up to 50% increased risk of operative mortality, while increased risk of 21% was noted in the moderately obese.[16] They also demonstrated an increased risk of post-operative renal failure in both groups of obese patients.[16] In contrast, Kuduvalli et al found no difference in risk between obese patients and their slimmer counterparts in developing renal failure.[8]

Attempts to assess the impact of obesity on long-term CABG outcomes have been made by several observational studies that analysed the long-term survival of patients (Table 2). Aside from Kim et al,[13] all groups demonstrated that obese patients, particularly extreme ones, suffered from increased 4- or 5-year mortality, with the adjusted relative risk ranging from 1.28-1.79 compared with non-obese patients.[17 21-23] However, apart from Gurm et al, studies failed to identify whether the cause of death was of cardiac origin. While Gurm et al reported a linear rise in risk of cardiac mortality with increasing BMI, they included only 28 and 103 patients respectively in the groups of underweight (BMI<20) and severely obese (BMI>35).[21] Such small samples at the extremes of BMI undermine the statistical power of the results. No data is available in the literature to compare long-term vein-graft quality or incidence of graft failure between obese and non-obese patients.

Should obese patients be offered CABG in the same way as non-obese patients?

Current clinical evidence has been conflicting over the effect of obesity on short-term CABG outcomes. Besides increased risk of wound complications, post-operative arrhythmias and prolonged length of stay, most recent studies show that obese patients have similar short-term outcomes as non-obese ones. However, the contrasting results of Prabhakar et al[17] are significant because of the study's large sample size.

Although most studies suggest that obesity has adverse impact on long-term CABG outcomes, the evidence is not convincing. The findings of greater long-term post-operative mortality in obese patients can be confounded by the increased likelihood of non-cardiovascular morbidity and mortality as a result of obesity. The significance of increased cardiac mortality in obese patients found by Gurm et al is weakened by the study's small sample size.[22] For the effect of obesity on long-term CABG outcomes to be adequately assessed, other important parameters including graft quality, incidence of post-operative cardiac events, and quality of life need to be taken into account.

Conclusion

The available evidence is limited, so there are no grounds for obese patients being denied CABG when this operation constitutes the most appropriate therapy. Instead of avoiding the selection of obese patients for CABG, as some clinicians admit, efforts should focus on preventing serious post-operative complications by appropriate perioperative precautions and on-going monitoring and treatment. The role of therapeutic measures, such as aggressive pre- and post- operative weight loss regimens, in improving CABG outcomes of obese patients should also be investigated by future randomised-controlled studies.

Table 2
Survey of various publications studying obesity and long-term CABG outcomes[b]

	Kim et al[13] (2003)	Kuduvalli et al[22] (2003)	Gurm et al[21] (2002)	Schwann et al[17] (2001)	Birkmeyer et al[23] (2000)
No. of patients	6728	4713 1	526	3560	10,686
Confounding factors adjusted	yes	yes	yes	yes	yes
4- or 5-year mortality	=	▲	▲	▲ (only BMI>34)	▲ (only BMI>37)
5-year cardiac mortality			▲		

[b] ▲ increased risk in obese patients; ▼ decreased incidence in obese patients; =, no difference between obese and non-obese

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