Does use of a right internal thoracic artery increase deep wound infection and risk after previous use of a left internal thoracic artery?

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Objective: To determine whether adding right internal thoracic artery to previous left internal thoracic artery bypass at reoperation increases deep sternal wound infection and hospital mortality, particularly in diabetic patients.

Methods: Reoperations (n = 2875; 2381 men) in patients with previous left internal thoracic artery bypass were performed between January 1990 and January 2003; 1939 (67%) had no repeat internal thoracic artery grafting, 923 (32%) received an additional right internal thoracic artery graft, and 13 (0.5%) had bilateral internal thoracic artery grafting with reuse of the left internal thoracic artery. Of the patients, 352 (12%) were insulin-treated and 590 (21%) non–insulin-treated diabetics. Multivariable logistic regression analysis was used to identify preoperative variables associated with right versus non–right internal thoracic artery use in diabetics and nondiabetics and to formulate propensity models. Propensity scores were used for matching and adjusted multivariable analyses of deep wound infection and hospital mortality.

Results: Deep wound infection occurred in 3.0% (7/230) of diabetics receiving right internal thoracic artery grafts, 2.2% (5/230) of propensity-matched diabetics receiving non–right internal thoracic artery grafts ($P = .6$), in 1.1% (6/538) of nondiabetics receiving right internal thoracic artery grafts, and in 1.0% (5/538) of matched non-diabetic patients receiving non–right internal thoracic artery grafts ($P = .8$). Corresponding hospital mortality in these matched groups was 1.7% (4/230) versus 6.1% (14/230) for diabetics ($P = .02$) and 2.6% (14/538) versus 3.5% (19/538) for nondiabetics ($P = .4$). Risk factors for deep wound infection included higher weight ($P = .0003$), higher New York Heart Association functional class ($P = .03$), and less severe left anterior descending disease ($P = .03$). Risk factors for death were ($P < .02$) emergency operation, mitral valve replacement, and greater number of saphenous vein grafts.

Conclusions: Use of the right internal thoracic artery for reoperations does not increase the risk of deep wound infections in diabetics or nondiabetics and does not increase mortality.

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Use of the left internal thoracic artery (LITA) for coronary artery bypass is safe and associated with improved long-term survival compared with saphenous vein grafting. Bilateral internal thoracic artery (ITA) grafting is associated with an even greater survival advantage.[1-3] However, it has been shown to increase the risk of wound infection in some patients, particularly those with diabetes.[4-19] We sought to determine whether patients who received a LITA graft at their first operation were at increased risk of deep wound infection when the right

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Abbreviations and Acronyms
CL = confidence limits
DWI = deep wound infection
ITA = internal thoracic artery
LAD = left anterior descending coronary artery
LITA = left internal thoracic artery
RITA = right internal thoracic artery

internal thoracic artery (RITA) was used for the second operation, a staged use of bilateral ITAs.

Patients and Methods

Using the Cardiovascular Information Registry, we identified reoperations performed at The Cleveland Clinic Foundation between January 1990 and January 2003 on 2875 patients who previously had received a LITA graft. This registry has been approved for use in research by the Institutional Review Board. Average age was 66 ± 9.2 years, average weight was 83 ± 15 kg, and 2381 patients (83%) were men. One thousand nine hundred thirty-nine (67%) had no repeat ITA grafting, 923 (32%) received an additional RITA, and 13 (0.5%) had bilateral ITA grafting because the LITA could be used again.

Three hundred fifty-two patients (12%) had insulin-treated diabetes and 590 (21%), non–insulin-treated diabetes. Diabetes status could not be ascertained for 19 patients (0.7%). Thus, analysis evaluating the influence of diabetes involved 2856 patients.

Q wave infarction was present in 885 patients (31%), 68 (2.4%) underwent emergency operation, and 42 (1.8%) had endocarditis. Aortic valve replacement was performed in 471 (16%), mitral valve repair in 275 (9.6%), and mitral valve replacement in 121 (4.2%). Patent LITAs were dissected out and clamped during reoperations, with retrograde blood cardioplegia relied on to protect the territory. In patients undergoing only mitral valve, aortic valve, or aortic surgery, particularly with deep hypothermia, the LITA was not necessarily isolated and clamped only if a right-sided bypass was needed. Average aortic clamp time was 90 ± 32 minutes, and average cardiopulmonary bypass time was 130 ± 47 minutes. Patients received cefuroxime as a prophylactic antimicrobial, except high-risk patients, who were given vancomycin.

Deep wound infection (DWI) was defined as in the Society of Thoracic Surgeons database: a sternal wound infection requiring operative intervention and excision of muscle, bone, or mediastinal tissue associated with positive wound cultures or treatment with antibiotics or antimicrobials. Superficial wound infections were not compared.

Intraoperative and postoperative blood glucose management evolved over time as its importance was increasingly recognized.[13,14] Currently, all glucose levels above 150 $mg \cdot dL^{-1}$ are treated with intravenous insulin. Similarly, during this period, skeletonization of ITAs was increasingly used, particularly for the RITA to obtain greater length to bypass distal right coronary territory arteries.[8,18] For the past 2 years, vacuum dressings have been used for DWI.

Data Analysis

Multivariable logistic regression analysis was used to identify preoperative variables associated with RITA versus non-RITA use in diabetics and nondiabetics. These were amplified with nonstatistically significant variables to develop propensity models for fair comparison of RITA and non-RITA patients.[20,21] Four propensity scores were calculated for each patient:

1. RITA versus non-RITA use in diabetics
2. RITA versus non-RITA use in nondiabetics
3. Diabetics versus nondiabetics receiving RITA grafts
4. Diabetics versus nondiabetics not receiving RITA grafts

Comparison of DWI and hospital mortality was made between propensity-matched groups. In addition, risk factors were identified for DWI and hospital mortality using bagging (250 bootstrap data sets with a retention criterion of $P \leq .05$).[22] Final risk factor models were adjusted by the propensity scores.[23]

Presentation

Continuous variables are summarized by means and 1 standard deviation. Categorical variables are summarized as frequencies

TABLE 1. Deep wound infection in nondiabetic and diabetic patients who did or did not receive RITA grafts at reoperation*

RITA grafting at reoperation	Nondiabetics				Diabetics			
		DWI				DWI		
	n	No.	%	CL (%)	n	No.	%	CL (%)
Unmatched patients								
Yes	623	6	0.96	0.6-1.4	271	9	3.32	2.3-4.8
No	1287	9	0.70	0.5-0.9	675	11	1.63	1.2-2.3
P	.5				.1			
Total	1910	15	0.79		946	20	2.1	
Matched patients								
Yes	538	6	1.12	0.7-1.8	230	7	3.04	1.9-4.6
No	538	5	0.93	0.5-1.6	230	5	2.17	1.2-3.6
P	.8				.6			
Total	1076	11	1.02		460	12	2.6	

CL, Confidence limits; *DWI,* deep wound infection; *RITA,* right internal thoracic artery. *In 19 patients, diabetes status could not be ascertained.