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## Preoperative dobutamine stress echocardiography versus cardiac arteriography for risk assessment prior to renal transplantation

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**Abstract** Because coronary artery disease is the leading cause of death in patients with end-stage renal disease, we *prospectively* studied the prognostic value of dobutamine stress echocardiography (DSE) compared to coronary angiography (CA) as an evaluative tool. Thirty-three patients at high risk for coronary artery disease were selected from a cohort of 133 renal transplant candidates and underwent both DSE and CA. In this study, the value of DSE was found to exist in its strong negative predictive value

(92%). A negative DSE coupled with a negative clinical cardiac evaluation was found to practicably exclude the necessity for CA. DSE can thus serve as a non-invasive, low cost screening test.

**Key words** DSE · Kidney transplantation · Coronary artery disease

### Introduction

Coronary artery disease (CAD) is the primary cause of death among patients with end-stage renal disease (ESRD) worldwide [1–7], the risk of cardiac death being 20 times higher for ESRD patients than age-matched controls 35–54 years of age [6]. For all patients with ESRD (regardless of treatment modality), the death rate from cardiovascular disease has been reported to be 3.5 times the rate for age-matched populations 45–74 years old [8]. With these facts in mind, and knowing the ever-greater disparity between organs needed and organ availability, it is imperative that adequate pre-operative assessment of appropriate risk factors (particularly cardiac) be undertaken in order to more appropriately accept or deny patients for renal transplant reciprocity, to insure better long-term outcome, and thereby to make better utilization of available organs.

In the present study, a cohort of dialysis-dependent renal transplant candidates with significant cardiac risk factors was evaluated by prospectively comparing both

dobutamine stress echocardiography (DSE) and coronary angiography (CA) study results, with the goal of improving patient selection, outcome, and organ utilization. In this small study, 12% (4/33) of all patients were rejected from eligibility for renal transplantation, having been: (a) identified by high cardiac risk factors, (b) evaluated both by DSE and CA, and (c) judged not to be candidates for revascularization, thus, hopefully making for better utilization of organs.

### Materials and methods

#### Patients

All 133 dialysis-dependent renal transplant candidates evaluated at our medical center between 1 January 1993 and 1 March 1995 were screened for cardiac high-risk factors (identified as those with diabetes mellitus, previous myocardial infarction, age 50 years or more cerebral and/or peripheral vascular disease, congestive heart failure, class I or II angina (Canadian Cardiovascular Society classification), and dialysis dependency of more than 5 years). Patients were excluded who had evidence of severe valvu-

lar disease, class III-IV angina, refused to participate in the study, and/or had previously undergone recent CA or revascularization procedures prior to entering the study. Both DSE and CA were performed in all other high-risk patients ( $n = 33$ ).

#### Dobutamine stress echocardiography

DSE was performed the day after dialysis to avoid a hypertensive blood pressure response from volume overload. A standard DSE protocol, as previously reported from our laboratory, was utilized [9], DSE findings being graded as negative if normal wall motion was present and positive when any of the following were present: (1) CAD: fixed, inducible, or mixed segmental wall motion abnormalities, (2) cardiomyopathy: diffuse wall motion abnormalities, or (3) primary valvular heart disease: severe aortic stenosis, aortic insufficiency, mitral stenosis, or mitral regurgitation secondary to primary leaflet abnormalities.

#### Coronary arteriography

Coronary arteriography results were based upon visual estimation of epicardial coronary stenosis (%) and were considered positive for significant CAD when > 70% stenosis existed in one or more major epicardial coronary arteries or > 50% stenosis existed in the left main coronary artery, and negative if neither of the mentioned findings were present.

#### Study end-point

The goal of the study was to determine the predictive accuracy of DSE in identifying those patients (considered high-risk cardiac) who need not undergo pretransplant coronary arteriography, and to delineate their outcome as to whether or not they were added to the transplant reciprocity list.

#### Results

Forty-two of 133 (32%) patients evaluated for possible renal transplantation met the high-risk criteria for CAD; 9 patients were excluded because of prior coronary angiography ( $n = 5$ ), class III-IV angina ( $n = 3$ ), and refusal to participate in the study ( $n = 1$ ). The 33 remaining patients served as the study population. Of the 33 patients, 20 had (+)DSE of whom 12 had (+)CA (60%). Thirteen patients had (-)DSE of whom only 1 had (+)CA (8%) (Fig. 1).

Of the 12 patients who were both DSE and CA (+), 4 were rejected from transplant consideration, 4 underwent coronary artery bypass grafting (CABG) prior to listing, and 4 were managed expectantly prior to transplantation (of whom 1 was successfully transplanted, 1 died of a gastrointestinal hemorrhage, 1 died from myocardial infarction (MI), and 1 sustained an MI managed with CABG). The one patient who was DSE (-) but CA (+) underwent percutaneous transluminal coronary angioplasty and was subsequently added to the transplant reciprocity list.

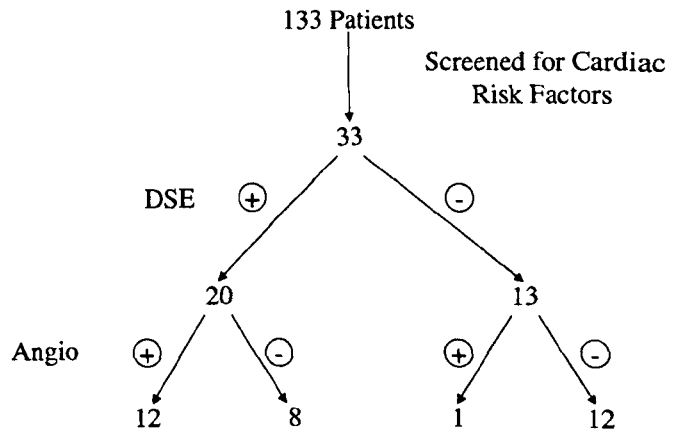


Fig. 1 Dobutamine stress echocardiography (DSE) and coronary angiography (Angio) results from high-risk renal transplant recipients

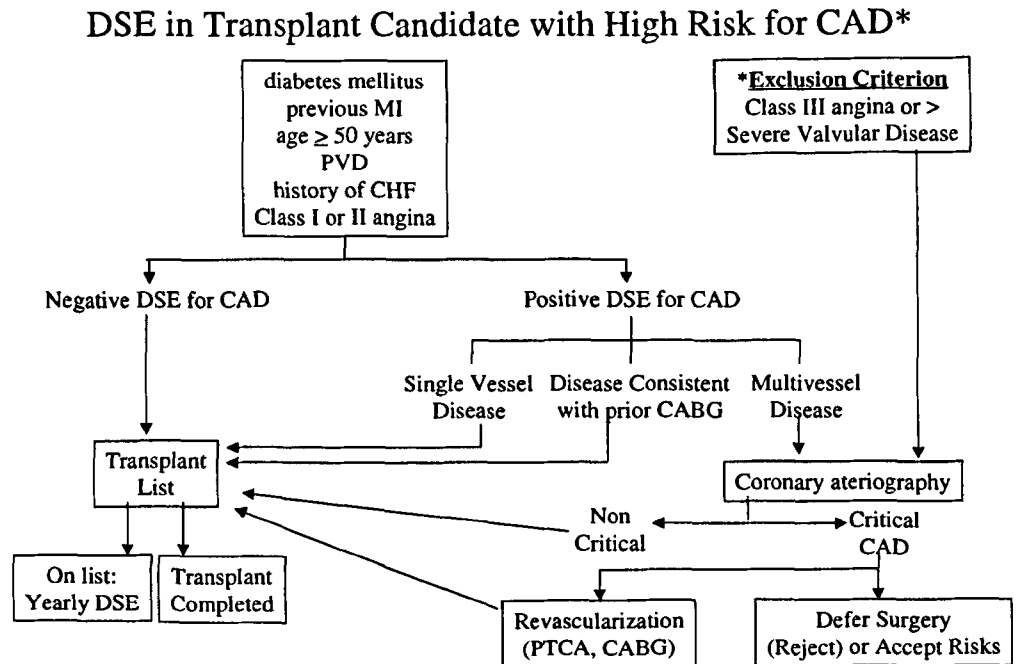
#### Discussion

Multiple studies have shown cardiac catheterization to be of benefit in high-risk populations and that early revascularization has significant advantages for long-term survival [10, 11]. However, cardiac catheterization is not a risk-free procedure [12] and is also an expensive way to screen patients for CAD when others options are available (the cost of CA approximating \$US 1000 compared with \$US 203 for DSE). Some renal transplant centers routinely perform diagnostic arteriography and coronary revascularization in asymptomatic or mildly symptomatic patients with significant CAD prior to placing these patients on the transplant reciprocity lists.

DSE has been validated as an accurate screening test for CAD [9, 13], and early studies have demonstrated that it can reduce the need for routine CA [1, 14-16]. No prior prospective studies comparing the use of both DSE and CA have been performed in the renal transplant population. Therefore, the diagnostic accuracy of DSE for identifying patients with severe CAD who would benefit from coronary revascularization prior to transplantation, or be rejected as transplant candidates, could not be evaluated.

Our results indicate that DSE is a reliable, practical, non-invasive cardiac screening tool to exclude patients from further cardiac intervention, thereby obviating the need for other expensive, invasive testing. In this study, DSE has a negative predictive value approaching 92%. This suggests that DSE could be beneficial in reducing the number of preoperative CAs. These results are obtained at the cost of a poor positive predictive value (60%) which indeed would mandate CA in the event of a (+)DSE. However, a (-)DSE coupled with a negative clinical cardiac evaluation can practicably predict a successful outcome (for example, no necessity for CA),

**Fig. 2** Algorithm for evaluation of the renal transplant candidate (to determine cardiac risk). *MI* Myocardial infarction, *PVD* peripheral vascular disease, *CHF* congestive heart failure, *CAD* coronary artery disease, *CABG* coronary artery bypass grafting, *PTCA* percutaneous transluminal coronary angioplasty



enabling the patient to be placed on a transplant recipient list.

The limited number of available organs for donation mandates appropriate preoperative evaluation to exclude unacceptable candidates. Cardiac status clearly impacts upon patient eligibility by defining the necessity for preoperative management (intervention), and allowing speculation of decreased peri-operative transplant mortality while enhancing allograft/patient survival. From our experience, we have developed the follow-

ing algorithm for cardiac assessment of the renal transplant candidate (Fig. 2).

The ability to utilize DSE as a screening tool to determine which patients will not require pretransplant cardiac intervention will be a product of both cost and morbidity as defined by future outcomes, with successful utilization of DSE being based largely upon clinical expertise and acumen. Further prospective studies are essential to determine the true value of DSE, and one is currently underway at our center.

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