

CORRESPONDENCE

**Research
 Correspondence**

Frequency and Pattern of Left Ventricular Dysfunction in Potential Heart Donors

Implications Regarding Use of Dysfunctional Hearts for Successful Transplantation

To the Editor: Cardiac transplantation is a widely accepted treatment for patients with advanced heart failure. Unfortunately only 1 in 8 hearts offered for donation is accepted for transplantation (1). Some donor hearts may be rejected due to left ventricular systolic dysfunction (LVSD) noted on initial assessment (2). In our study, we sought to evaluate the frequency and pattern of LVSD as well as to determine change in left ventricular (LV) function over time in such patients.

Acute brain injury (ABI) is the most frequent cause of death in potential donors, and LVSD is a well-reported abnormality in these patients (3–6). Systolic dysfunction has an incidence of up to 45% in patients with ABI and other neurological injuries (2,4,6,7). Left ventricular dysfunction in such a setting is often reversible over time and is postulated to be due to transient catecholamine surge that accompanies ABI, rather than coronary artery disease (1–8). We report a single-center series assessing the frequency and pattern of LVSD in potential heart donors.

Thirty-four adult organ donors were evaluated for LVSD by echocardiography or angiography. The pattern of predominant wall motion abnormality was noted at baseline and, when available, on serial examinations. We also reviewed information regarding cause of ABI and pressor usage.

Our data revealed a young cohort (mean age of 38 years) consisting of 22 males and 12 females. The most common causes of death were gunshot wounds to the head followed by motor vehicle accidents. The majority of potential donors, (23 of 34, 68%) had normal LV function. Patients with LVSD (11 of 34, 32%) could be classified into 4 distinct groups based on the anatomical location of the dysfunction: apical (2 of 11), basal (3 of 11),

midcavity (1 of 11), and diffuse global (5 of 11). Five patients (45%) underwent repeat assessment of their LVSD, and all demonstrated improved systolic function. Furthermore, in 3 patients, the ejection fraction (EF) normalized. As seen in Table 1, the improvement was seen as early as 3 h after the initial assessment. Data on pressor usage revealed that exogenous catecholamines did not contribute to worsening or improvement in LV function.

In our series, we noted that nearly one-third of the potential donors had LVSD on initial assessment. In those with follow-up studies, LVSD improved in all regardless of type of initial pattern of dysfunction. Furthermore, in 3 patients, there was a complete normalization of LV systolic function. Unfortunately, only 1 of the 11 donors with LVSD was accepted for transplant. The patient with an initial EF of 30% (last patient in Table 1) had assessment 10 h later indicating improvement in EF, and the heart was procured. An echocardiogram performed immediately after transplant showed an EF of 60%. Subsequent examinations demonstrated that normal LV systolic function was maintained.

It is well known that a catecholamine surge is seen in patients with ABI (1,3–7,9). Studies have indicated that serum levels of catecholamines correlate with the severity of neurological injury and outcome (5). This catecholamine excess is thought to induce LVSD in susceptible patients (1,3,5,6,8). Autopsy data have confirmed myocardial band necrosis, also known as myocytolysis without ischemic necrosis (3,6) in patients suffering from ABI. This finding, in patients who had new LVSD after an ABI, is consistent with catecholamine toxicity (1,3,4,6). At a cellular level, adrenergic hyperstimulation is thought to lead to pathological

Table 1 Summary of 11 Potential Donors With Cardiac Dysfunction

Age (Yrs)	Sex	Cause	Dysfunction Pattern	Peak Troponin I	Peak CK-MB	Pressors	Initial EF	Repeat EF	Repeat EF Time Frame
31	Male	Head trauma	Diffuse global	0.55	7.0	Desmopressin, phenylephrine	34%	45%	10 h
46	Male	Drug overdose	Diffuse global	9.57	27.6	Dopamine, norepinephrine	40%		
25	Male	Vehicle accident	Diffuse global	0.36	38.9	Dopamine, phenylephrine	25%	60%	10 h
20	Male	Gun shot head	Basal	1.55	22.0	Norepinephrine	45%		
45	Female	Drug overdose	Diffuse global	2.92	6.5	Dopamine, phenylephrine	12%		
20	Male	Gun shot head	Diffuse global	0.73	33.9	Desmopressin	30%		
55	Female	SAH	Basal	NA	14.7	Desmopressin, phenylephrine	43%		
18	Male	Gun shot head	Midcavity	4.14	14.1	No pressors	35%	41%	3 h
63	Male	SAH	Basal	3.22	17.6	Desmopressin	40%		
51	Female	Cardiac arrest	Apical	0.32	14.1	Desmopressin	35%	56%	36 h
23	Male	Gun shot head	Apical	NA	NA	Phenylephrine	30%	60%	10 h

CK-MB = creatine kinase-myocardial band; EF = ejection fraction; NA = not available; SAH = subarachnoid hemorrhage.

myocyte calcium influx through myocardial 3',5'-cyclic adenosine monophosphate production, leading to adenosine triphosphate depletion (1,4,10).

The catecholamine-induced cardiac dysfunction, often termed "neurogenic stress cardiomyopathy," bears many similarities to Takosubo cardiomyopathy (4,7,8). Takosubo cardiomyopathy is thought to be induced by catecholamine excess, and manifests with apical wall motion abnormalities that do not correlate with a coronary distribution (3,4,6). In contrast to classic Takosubo cardiomyopathy, neurogenic stress cardiomyopathy most frequently presents with global hypokinesis (4). In our study, the global pattern of LVSD (45%) was predominant, followed by basal/mid cavity pattern (36%). The apical pattern constituted only 18% of our patients.

It has been previously thought that patient with neurogenic stress cardiomyopathy normalize their LV function within days to weeks (1). In potential donors with ABI, waiting for such time for normalization of LV function will be unreasonable. In our study, the repeat assessment of LV function ranged from 3 to 36 h. Our findings suggest that an initial examination showing LVSD should not exclude a potential heart donor. Serial assessment should be undertaken in all potential donors who have ABI before excluding cardiac procurement. Reassessment over time and possibly temporizing organ procurement may permit LV function to improve enough that procurement is reasonable, and will increase the pool of hearts available for transplantation.

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Letters to the Editor

Does New Onset Atrial Fibrillation Have a True Impact on the Incidence of Stroke After Transcatheter Aortic Valve Implantation?

We read with interest the paper by Amat-Santos et al. (1) describing the importance of new-onset atrial fibrillation (NOAF) after transcatheter aortic valve implantation (TAVI). They describe an association between NOAF and embolic events (EE), suggesting that NOAF may be a mechanism for late neurological events after TAVI. However, we believe that the adjudication of the EE overestimates the association and impairs the generation of a hypothesis of causality.

The association of TAVI with NOAF and EE is biologically plausible following Bradford Hill's classic causality criteria (2). But another criterion is temporality: the cause must precede the effect. Nonetheless, Patient #4 and Patient #6 from Table 4 (1) had the embolic event 48 h and 18 days, respectively, before the NOAF episode (1). Therefore, those EE should not be attributed to NOAF. Patient #10 from Table 4 (1) had a stroke 645 days after TAVI (640 days after NOAF), and moreover, was under warfarin treatment with an international normalized ratio of 2.2 at hospital admission. Thus, it is doubtful that this stroke may have a causal relation to the TAVI procedure.

Besides the statistical limitation of a low number of events, if we remove these 3 events from the NOAF group, there are 3 remaining strokes at 30 days (incidence 6.8% vs. 3.2% in the no-NOAF group; odds ratio: 2.22, 95% confidence interval: 0.43 to 11.47, unadjusted $p = 0.330$). The incidence of stroke/systemic embolism at 30 days would be 9.1% versus 3.2% (odds ratio: 3.03, 95% confidence interval: 0.65 to 14.18, unadjusted $p = 0.141$). Thus, the incidence of EE at 30 days does not reach statistical significance, and has a poor clinical and causal significance. The cumulative incidence at follow-up would only add 1 event with uncertain causal relationship to TAVI.

Stroke is a major concern in TAVI, accounting for as many as 11% of deaths at 1 month (3). In a smaller series with 91% transfemoral TAVI, our group found 6% NOAF, with no impact on EE (6%) or mortality during a mean follow-up of 11 months (4). Left atrial appendage might be a source of thrombus in NOAF after TAVI, but is still unconfirmed. It would be revealing if the authors provided information about transesophageal echocardiography. The presence of thrombus in the left atrial appendage before or during the TAVI procedure could contribute to support the AF hypothesis as a mechanism of the late embolic events.