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Outcomes of elective versus emergent permanent mechanical circulatory support in the elderly: A single-center experience

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BACKGROUND: Advanced age is considered a relative contraindication to heart transplantation, but there is no published consensus on critical age in the case of mechanical circulatory support (MCS). This single-center study investigated outcomes of elective versus emergent implementation of permanent MCS in the elderly.

METHODS: Between January 1, 2006 and April 1, 2009, 31 patients, >65 years of age, were supported with a ventricular assist device (VAD), intended for permanent support, at our institution. The 28 left VAD (LVAD) recipients were divided into two groups: a survival group, $n = 13$ (ongoing MCS at 180 days or weaned); and a non-survival group, $n = 15$ (death on device within 180 days). In addition, the survival rate of LVAD recipients according to pre-operative INTERMACS (Interagency Registry for Mechanically Assisted Circulatory Support) status was analyzed.

RESULTS: The cumulative survival rates for the LVAD patients were 75% at 30 days, 46% at 180 days and 39% at 1 year after VAD implantation. The cumulative survival rates at 30 days, 180 days and 1 year were 71%, 47% and 35% for INTERMACS Level I to III ($n = 17$) patients vs 81%, 45% and 45% for INTERMACS Level IV to V ($n = 11$) patients ($p = 0.9$), respectively. Median age of LVAD recipients was 69 (range 66 to 80) years; 4 were women. Median support time was 565 (range 228 to 1,257) days. In 9 recipients support is ongoing. Both complications profiles and causes of death are reported.

CONCLUSIONS: Our experience indicates that permanent MCS may be successful in highly selected elderly patients with terminal heart failure, especially when elective implantation is performed before development of inotropic dependency or cardiogenic shock. However, outcomes at 12 months in this selective elderly population remain uniformly poor.

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Heart failure is a leading cause of death in developed nations, despite medical management. The prevalence of heart failure in Europe is 0.3% to 2%, and it affects approximately 10 million people living in nations represented by the European Society of Cardiology. Heart transplantation remains demonstrably the best clinical outcome in patients with end-stage heart failure, but this option is limited by increased shortage of donor organs. Presently, mechanical

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circulatory support (MCS) devices have gained wide acceptance as bridge to transplantation or as permanent support,[1] especially in the past 10 years, since miniaturized continuous flow pumps were introduced into clinical practice.[2] The rate of post-operative complications in these pumps has decreased continuously with new developments and experience gained.[3,4] Advanced age was shown in some studies to be a risk factor,[5–7] but in recent years the percentage of ventricular assist device (VAD) recipients >65 years of age, in the presence of established contraindications for cardiac transplantation, has continuously increased.[7]

Although advanced age is considered to be a relative contraindication for heart transplantation, there is no consensus as yet on critical age for MCS implementation. This single-center study investigated results of VAD implantation in patients of advanced age (>65 years) with end-stage heart failure.

Methods

Between January 1, 2006 and April 1, 2009, 309 VADs for long-term support were implanted at our institution. Thirty-one recipients were >65 years of age and support was intended to be permanent. All study patients were followed up until death, device explantation (in 1 case of myocardial recovery) or day of last observation, on September 1, 2009.

Twenty-eight LVADs were implanted in this period in patients >65 years old. These patients were divided into 2 groups: a survival group, $n = 13$ (ongoing MCS at 180 days or weaned); and a non-survival group, $n = 15$ (death on device within 180 days). Several devices were used during the study period in this age cohort, including pulsatile- and continuous-flow LVADs. Two biventricular VAD (BVAD) Berlin Heart EXCOR (Berlin Heart AG, Berlin Germany) recipients and 1 CardioWest total artificial heart (TAH; CardioWest SynCardia Systems, Tucson, AZ) recipient were also analyzed and are presented separately.

Kaplan–Meier analysis according to the pre-operative INTERMACS (Interagency Registry for Mechanically Assisted Circulatory Support) status[8] was performed in 2 groups: an inotrope-dependent group (INTERMACS I to III, $n = 17$); and an inotrope-free group (INTERMACS IV to V, $n = 11$).

The inotropic score was calculated as previously described.[9,10] Briefly, the doses of dopamine, dobutamine and enoximone (in micrograms per kilogram body weight per minute) were added; the dose of milrinone was multiplied by 15 and doses of epinephrine and norepinephrine by 100 and then added. Vital status immediately before surgery was documented using the Simplified Acute Physiology Score (SAPS II), described in detail elsewhere.[11] The following data were collected and score points calculated: age; heart rate; systolic blood pressure; body temperature (in degrees Celsius); PaO_2/FIO_2; urine output; serum blood urea nitrogen (BUN); white blood cell (WBC) count; serum potassium, sodium and bicarbonate levels; bilirubin plasma level; Glasgow coma score; documented history of chronic disease (acquired immunodeficiency syndrome [AIDS], hematologic malignancy, metastatic cancer); and type of admission.

Statistics

Statistical analysis was performed with SPSS, version 10.0.0 for Windows (SPSS, Inc., Chicago, IL). Data are presented as median and range. Comparisons were performed using Student's *t*-test or the Mann–Whitney *U*-test. Qualitative variables were analyzed by Fisher's exact test. Logistic regression analysis was performed to identify risk factors for death. $p < 0.05$ was considered statistically significant. Survival estimates were based on the Kaplan–Meier method.

Results for LVAD patients

Cumulative survival rates for the LVAD patients were 75% at 30 days, 46% at 180 days and 39% at 1 year after device implantation.

Cumulative survival rates for INTERMACS Level I to III patients were 71% at 30 days, 47% at 180 days and 35% at 1 year. Survival rates of VAD recipients with INTERMACS Level IV to V were 81% at 30 days, 45% at 180 days and 45% at 1 year ($p = 0.9$) (Figure 1).

Median age of LVAD recipients was 69 (range 66 to 80) years; 4 of them were women. Nine patients were >70 years old. The oldest LVAD recipient was a female who was 80 years of age at the time of implantation.

The underlying cardiac pathology was dilative cardiomyopathy ($n = 13$) or end-stage heart failure from ischemic heart disease ($n = 15$). The majority of patients were referred from local hospitals where recompensation from heart failure had been attempted previously.

Six patients were in "critical cardiogenic shock" (INTERMACS Level I). Two LVAD recipients were resus-

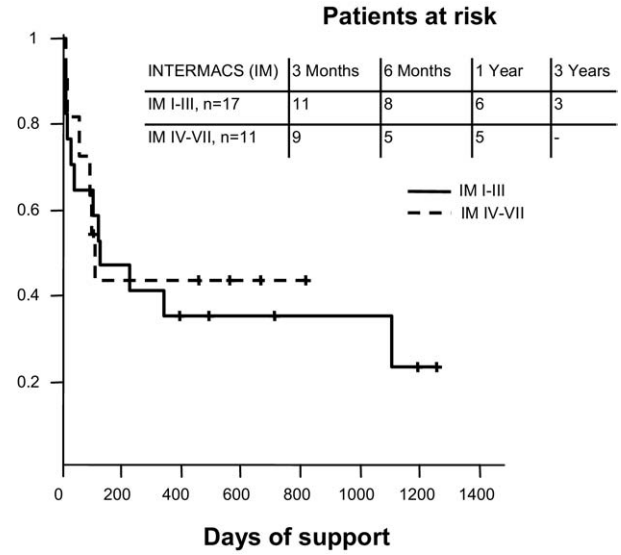

Figure 1 Survival after LVAD implantation in recipients of advanced age by INTERMACS patient profile.