Artificial intelligence derived age algorithm after heart transplantation

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Background: An artificial intelligence (AI) algorithm detecting age from 12-lead ECG has been suggested to signal "physiological age" of the individual. Importantly, increased physiological age gauged by an increased difference between ECG-age and chronological age has been associated with higher risk of cardiac events in non-transplant population.

Purpose: We sought to investigate the validity of the AI-derived ECG-age algorithm in patients who underwent heart transplantation and its relationship to major adverse cardiovascular events (MACE).

Methods: A total of 489 consecutive patients who had undergone heart transplantation in our institution between 1994 and 2018 were studied. AI-ECG age was calculated by a previously-trained artificial intelligence (AI) algorithm using a 12-lead ECG per patient. ECGs used in the training process of the algorithm were excluded. The average of the ECG-ages within one year before and one year after heart transplantation was used to represent pre- and post-transplant ECG-ages. MACE was defined as any incidence of revascularization, re-transplantation, and death.

Results: Pre-transplant ECG-age (mean 63±10 years) correlated significantly with recipient chronological age (mean 50±13 years, r=0.57, p<0.0001), but this correlation between recipient and ECG-ages was weakened after transplantation (mean post-transplant ECG age of 55±10 years, r=0.34, p<0.0001). Interestingly, post-transplant ECG-age correlated significantly with donor age (mean ECG age of 55±10 years vs. mean donor age of 32±13 years, r=0.42, p<0.0001). During a median (IQR) follow-up of 9 (5, 14) years, 251 patients had MACE. Mean change in ECG age after transplantation compared to before was –8.8±12.7 years. Patients who had an increase in ECG-age after compared to before transplantation showed increased risk of MACE (HR: 1.53 [1.16, 2.01], p=0.002), independent of recipient and donor ages (adjusted HR: 1.68 [1.26, 2.25], p=0.001); whereas there were no significant differences in risk of MACE in patients who were transplanted with an older donor heart (HR: 1.07 [0.77, 1.50], p=0.66). In a Kaplan Meier survival analysis, those with increased ECG-age after transplantation had significantly lower MACE-free survival compared to those with decreased ECG-age. (Log-rank P=0.002; Wilcoxon P=0.001) (Figure)

Conclusion: Post-transplant ECG-age correlates more faithfully with the donor's than the recipient's chronological age, suggesting that ECG-age more closely reflects cardiac age than the patient age. Furthermore, ECG-age derived cardiac aging after transplantation is associated with higher risk of MACE.