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Clinical paper

Associations among gender, marital status, and outcomes of adult in-hospital cardiac arrest: A retrospective cohort study☆

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ABSTRACT

Aim: To analyse the association between gender and outcomes of in-hospital cardiac arrest (IHCA) and the influences of age and marital status on the gender-based difference in clinical outcome.
Methods: This retrospective observational study conducted in a single medical centre evaluated patients who had experienced IHCA from 2006 to 2014. Multivariate logistic regression analysis was used to study associations between independent variables and outcomes. Patients 18–49 years old were considered of reproductive age. The presence or absence of a legitimate spouse was retrieved from the family pedigree presented in the medical records. Reproductive age and marital status were each analysed as an interaction term with gender.
Results: A total of 1524 patients, of which 598 were women (39.2%), were included in this study. There were 269 patients (17.7%) of reproductive age and 490 patients (32.2%) without a living spouse. Only 215 patients (14.1%) survived to hospital discharge. Among these, 110 patients (7.2%) demonstrated a favourable neurological status. Our analysis indicated that being female was inversely associated with a favourable neurological outcome (odds ratio [OR], 0.51; 95% confidence interval [CI], 0.29–0.87; $p = 0.02$). Being female without a living spouse was inversely associated with a favourable neurological outcome (OR, 0.43; 95% CI, 0.17–0.96; $p = 0.05$). Neither female nor female-associated interaction terms were significantly associated with survival to hospital discharge.
Conclusion: Female patients with IHCA had worse neurological outcomes than their male counterparts, especially for women without a living spouse. However, survival outcome did not differ between genders.

Introduction

In the United States, approximately 209,000 patients experience in-hospital cardiac arrest (IHCA) each year.[1] Despite continuing efforts to improve the quality of cardiopulmonary resuscitation (CPR), outcomes following IHCA remain poor. Only 20% of patients who experience IHCA survive to hospital discharge, and, if patients survive, as many as 28% suffer from significant neurological disabilities.[2]

Gender has been noted to correlate with outcomes following cardiac arrest.[3] However, most studies[3–8] addressing this issue have focused on out-of-hospital cardiac arrest (OHCA) and have shown conflicting results. In a meta-analysis, Bougouin et al.[3] demonstrated that compared with men, the women included in the studies tended to be older, more likely to have cardiac arrest at home, less likely to have witnessed cardiac arrest, more likely to present with nonshockable rhythms, and more likely to receive bystander CPR. After adjusting for these important prognostic fac-

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tors, Bougouin et al.[3] found that women are more likely than men to survive to hospital discharge after sudden cardiac arrest.

Nevertheless, results from recent studies, including patients from large registry databases (i.e. Pan Asian Resuscitation Outcomes Study[5] and Resuscitation Outcomes Consortium Epistry–Cardiac Arrest[6]) and the trial of Targeted Temperature Management,[4] indicate no gender-based difference in survival after OHCA. Moreover, by analysing patients of the International Cardiac Arrest Registry, Karlsson et al.[8] demonstrated that men are associated with better survival than women. Therefore, it appears that for patients with OHCA, the association between gender and survival may not be as significant as Bougouin et al.[3] had indicated. In contrast with the large number of studies investigating gender-based differences in survival after OHCA, few have been dedicated to examining IHCA.

In the current study, we analysed the association between gender and clinical outcomes of IHCA. Kitamura et al.[9] demonstrated that women of reproductive age have lower mortality after OHCA than men of a similar age, suggesting that oestrogen may be associated with the survival advantage in women. Additionally, Bushnell et al.[10] and Lisabeth et al.[11] noted that marital status correlates with neurological recovery in patients post stroke. Therefore, the influences of age and marital status on gender-based difference in clinical outcomes were also analysed in the present study.

Materials and methods

Setting

This retrospective cohort study was conducted at National Taiwan University Hospital (NTUH), a tertiary medical centre with 2600 beds, including 220 beds in intensive care units. This study was conducted in accordance with the amended Declaration of Helsinki. Before data collection, the Research Ethics Committee of NTUH approved this study and waived the requirement for informed consent (Reference number: 201601048RINB).

Participants

Patients who had experienced IHCA at NTUH from 2006 to 2014 were screened. Patients who met the following criteria were included in the study: (1) aged 18 years or older, (2) documented absence of pulse with performance of chest compression for at least 2 min, and (3) no documentation of a do-not-resuscitate order before arrest. If multiple cardiac arrest events occurred in a single patient, only the first event of each hospitalization was recorded. Patients who had experienced cardiac arrest related to major trauma were excluded from the study.

Data collection and outcome measures

The following information was recorded for each patient: age, gender, comorbidities (defined in Supplemental Table S1 in the online version at DOI: 10.1016/j.resuscitation.2016.07.005), variables derived from the Utstein templates,[12] and critical interventions implemented at the time of cardiac arrest or after sustained return of spontaneous circulation. The marital status was abstracted from the family pedigree documented in nursing records, which were routinely completed upon admission by the primary nurse. Only a legitimate spouse was recorded as a spouse in the family pedigree. The average onset age of menopause is approximately 50 years old.[13] Therefore, reproductive age was regarded in the present study as 18–49 years old.

The primary outcome was favourable neurological outcome at hospital discharge, and the secondary outcome was survival to hospital discharge. Favourable neurological outcome was defined as a score of 1 or 2 on the Cerebral Performance Category (CPC) scale.[14] The CPC scale is a validated 5-point scale of neurological disability (1, good cerebral performance; 2, moderate cerebral disability; 3, severe cerebral disability; 4, coma/vegetative state; 5, death). Patients with a CPC score of 1 or 2 have sufficient cerebral function to live independently. The research assistants who were blind to the study objective retrospectively determined the CPC score for each patient by reviewing the medical records.

Statistical analysis

The R software version 2.15.3 (R Foundation for Statistical Computing, Vienna, Austria) was used for data analysis. Categorical data are expressed as counts and proportions; continuous data are expressed as means and standard deviations. Categorical variables were compared with the Fisher's exact test, and continuous variables with the Wilcoxon rank-sum test. A two-tailed p-value of less than 0.05 was considered statistically significant.

The odds ratio (OR) was selected as the outcome measure, and multivariate logistic regression analysis was used to examine the associations between independent variables and outcomes. All available independent variables were considered in the regression model, regardless of whether they were significant by univariate analysis. A stepwise variable selection procedure (with iterations between the forward and backward steps) was used to obtain the final regression model. Significance levels for entry and to stay were set at 0.15 to avoid excluding potential candidate variables. The final regression model was calculated by excluding individual variables with a p-value greater than 0.05 until all regression coefficients were statistically significant. If the variable of interest was excluded during the variable selection procedure, it was added back to the final model to assess its effect.

Generalized additive models[15] were used to examine the nonlinear effects of continuous variables and, if necessary, to identify the appropriate cutoff point(s) for dichotomizing a continuous variable during the variable selection procedure. The interactions between gender and marital status/reproductive age were tested during the model-fitting process. The goodness-of-fit of the fitted regression model was assessed using c-statistics, adjusted generalized R^2, and the Hosmer–Lemeshow goodness-of-fit test.

Results

A total of 1537 adult patients received chest compressions for at least 2 min at NTUH from 2006 to 2014. Thirteen patients were excluded because of trauma-related cardiac arrest. We enrolled the remaining 1524 patients for further analysis.

Tables 1 and 2 provide the features of IHCA before, during, and after CPR for all patients in the cohort. Supplemental Tables S2–S5 in the online version at DOI: 10.1016/j.resuscitation.2016.07.005 provide these features stratified by gender/marital status and by gender/reproductive age. There were 598 female patients (39.2%). Overall, the mean age was 65.1 years. There were 269 patients (17.7%) aged 18–49 years. There were 490 patients (32.2%) without a living spouse. A total of 697 IHCA events (45.7%) occurred in intensive care units, and 730 events (48.0%) occurred on general wards. The majority (85.8%) of initial rhythms were nonshockable rhythms, including pulseless electrical activity and asystole. The average CPR duration was 34.7 min. Only 215 patients (14.1%) survived to hospital discharge; of these, 110 patients (7.2%) demonstrated favourable neurological status.

We placed all independent variables listed in Tables 1 and 2, as well as the pre-specified interaction terms, in the regression analysis for variable selection. As shown in Table 3, for the primary