Short paper

Women have worse cognitive, functional, and psychiatric outcomes at hospital discharge after cardiac arrest

Sachin Agarwal[a,*], Alex Presciutti[a], Jayati Verma[a], Marykay A. Pavol[a], Deepti Anbarasan[a], Daniel Brodie[b], Leroy E. Rabbani[b], David J. Roh[a], Soojin Park[a], Jan Claassen[a], Yaakov Stern[a]

[a] Department of Neurology, Columbia University College of Physicians & Surgeons, New York Presbyterian Hospital/Columbia, New York, NY 10032, United States
[b] Department of Internal Medicine, Columbia University College of Physicians & Surgeons, New York Presbyterian Hospital/Columbia, New York, NY 10032, United States

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ABSTRACT

Aim: To examine gender differences among cardiac arrest (CA) survivors' cognitive, functional, and psychiatric outcomes at discharge.

Methods: This is a prospective, observational cohort of 187 CA patients admitted to Columbia University Medical Center, considered for Targeted Temperature Management (TTM), and survived to hospital discharge between September 2015 and July 2017. Patients with sufficient mental status at hospital discharge to engage in the Repeatable Battery for Neuropsychological Status (RBANS), Modified Lawton Physical Self-Maintenance Scale (M-PSMS), Cerebral Performance Category Scale (CPC), Center for Epidemiological Studies Depression Scale (CES-D), and Post-Traumatic Stress Disorder Checklist – Civilian Version (PCL-C) were included. Fisher's exact, Wilcoxon Rank Sum, and regression analysis were utilized.

Results: 80 patients (38% women, 44% white, mean age 53 ± 17 years) were included. No significant gender differences were found for age, race, Charlson Comorbidity Index, premorbid CPC or psychiatric diagnoses, arrest related variables, discharge CPC, or PCL-C scores. Women had significantly worse RBANS (64.9 vs 74.8, p = .01), M-PSMS (13.6 vs 10.6, p = .02), and CES-D (22.8 vs 14.3, p = .02) scores. These significant differences were maintained in multivariate models after adjusting for age, initial rhythm, time to return of spontaneous circulation, and TTM.

Conclusions: Women have worse cognitive, functional, and psychiatric outcomes at hospital discharge after cardiac arrest than men. Identifying factors contributing to these differences is of great importance in cardiac arrest outcomes research.

Introduction

Gender differences in cardiac arrest (CA) exist; women are typically older, present with a higher rate of non-shockable rhythms, receive fewer therapeutic treatments over the course of their care, and experience higher in-hospital mortality when compared to men [1,2]. Moreover, post-stroke, women have been shown to have worse cognitive [3], functional [4], and psychiatric [5] outcomes at discharge even after adjusting for baseline differences in demographics and clinical variables. There is a paucity of data looking at these detailed outcomes after CA, which has been limited to crude scales such as the Cerebral Performance Category Scale (CPC) [2,6]. Thus, the current study aims to examine gender differences at hospital discharge after CA using in-depth cognitive, functional, and psychiatric outcomes.

Methods

Patient characteristics

This study is a subgroup analysis of an observational, prospective, cohort study evaluating the long-term evolution of cognitive, functional, and psychiatric manifestations of CA survivors. Patients were ≥18 years of age, resuscitated following either in-hospital or out-of-hospital CA, admitted to Columbia University Medical Center, considered for Targeted Temperature Management (TTM), and survived to hospital discharge between September 2015 and July 2017.

Screening procedure

Through daily ICU screening, potential subjects were identified

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using diagnostic codes and approached for written informed consent. Survivors with sufficient mental status to engage in an in-person neuropsychological exam and an evaluation for functional and psychiatric status at discharge were eligible. Sufficient mental status was defined as having a Cerebral Performance Category Scale (CPC) [7] of 3 or less, being alert and oriented to person, place, and date, and having no presence of delirium, agitation, or sedation according to the Confusion Assessment Method for the ICU [8] and the Richmond Agitation-Sedation Scale [9]. 191 of 358 admitted patients survived to hospital discharge; 85 (41 women) did not meet criteria for sufficient mental status. 106 patients were deemed eligible, of which 26 (11 women) declined to participate due to travel limitations for follow-up appointments as part of the parent study, and were therefore not included in the present analysis. 80 patients gave consent and were included in the final analysis. The study was approved by Columbia University's institutional review board.

Data collection

Following Utstein guidelines [10], demographic information (i.e. age, gender, race), pre-arrest variables (i.e. obesity, Charlson Comorbidity Index (CCI), CPC, psychiatric diagnoses), and arrest-related variables (i.e. arrest site, witnessed arrest, bystander cardiopulmonary resuscitation (CPR), initial rhythm, defibrillation, time to return of spontaneous circulation (ROSC), TTM administration) were collected. Cooling protocol has been published previously [11]. Details on TTM exclusion are attached in a supplementary file 1. Level of care provided was measured by the Simplified Therapeutic Intervention Scoring System (TISS-28) [12,13].

Outcome measures

Outcome measures were administered at hospital discharge (median 22 days from arrest date).

Cognitive status was measured through the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). The RBANS assesses immediate memory, semantic fluency, attention, visuospatial awareness, and delayed memory [14]. RBANS administration was performed by a single reviewer (AP) who was trained by a board certified neuropsychologist (MP). Results were scored according to the publisher's normative data.

Level of independence was calculated via the Lawton Physical Self Maintenance Severity Scale (M-PSMS) [15]. Functional status was measured via the CPC using a rubric (attached as supplemental file 2) [11]. Scores were adjudicated through physical and occupational therapy notes.

Psychiatric symptomatology was assessed via the Center for Epidemiological Studies Depression Scale (CES-D) [16] and the Post-Traumatic Stress Disorder (PTSD) Checklist – Civilian Version (PCL-C) [17], which are commonly used as interview-based diagnostic screeners for depression (CES-D score $\geq$ 16) [16] and PTSD (PCL-C score $\geq$ 36) [18], respectively.

Statistical analyses

Fisher's exact and Wilcoxon–Rank Sum tests were used to compare differences between genders in demographics, pre-arrest and arrest-related variables (Table 1), and recovery outcome measures (Table 2). Multivariate regression models were then created to explore associations between gender and outcome measures. Selection of variables included in the final models was based on either a statistical significance of p $<$ .05 or clinical importance based on prior studies. CPC greater than 2 was defined as severe cerebral disability.

Table 1
Admission Clinical Characteristics Comparing Women and Men.

Admission Clinical Characteristics	Women 37.5% (n = 30)	Men 62.5% (n = 50)	p-value
Demographics			
Age, mean ± SD	50.1 ± 17.0	54.6 ± 17.0	.24
Race, % (n)			.74
-White	40.0 (12)	46.0 (23)	
-Black	23.3 (7)	26.0 (13)	
-Hispanic	26.7 (8)	16.0 (8)	
-Asian	10.0 (3)	12.0 (6)	
Premorbid Information			
Obesity (BMI > 30 m/kg^2), % (n)	14.8 (4)	18.0 (9)	1.00
CCI, median (IQR)	3 (0.5–4)	2 (1–4)	.84
Premorbid CPC, % (n)			0.78
-CPC 1	96.6 (28)	94.0 (47)	
-CPC 2	0.0 (0)	4.0 (2)	
-CPC 3	3.5 (1)	2.0 (1)	
Premorbid Psychiatric Diagnoses, % (n)	6.7 (2)	10.0 (5)	.71
CA Variables			
In-hospital Arrests, % (n)	58.6 (17)	78.0 (39)	.09
Witnessed Arrest, % (n)	92.9 (26)	93.6 (44)	1.00
Bystander CPR, % (n)	85.2 (23)	95.6 (43)	.18
Initial Rhythm, % (n)			.78
-Ventricular Tachycardia/ Fibrillation	43.3 (13)	49.0 (24)	
-Pulseless Electrical Activity	46.7 (14)	44.9 (22)	
-Asystole	10.0 (3)	6.1 (3)	
Defibrillation, % (n)	51.7 (15)	51.0 (25)	.52
ROSC (minutes), median (IQR)	5 (2–20)	10 (3–15)	.93
TTM Administration, % (n)	26.7 (8)	40.0 (20)	.33
TISS-28, median (IQR)	28.5 (26–33)	27.0 (23–33)	.41
Length of ICU Stay (days), median (IQR)	9 (4–18)	9 (6–17)	.51
Length of Hospital Stay (days), median (IQR)	19.5 (10–35)	27.5 (11.5–37.5)	.48

Abbreviations: SD = Standard Deviation, BMI = Body Mass Index, CCI = Charlson Comorbidity Index, IQR = Interquartile Range, CPC = Cerebral Performance Category Scale, CPR = Cardiopulmonary Resuscitation, ROSC = Return of Spontaneous Circulation, TTM = Targeted Temperature Management, ICU = Intensive Care Unit, TISS-28 = Therapeutic Intervention Scoring System.

Results

Admission clinical characteristics

Overall our sample is young (mean age 53 ± 17 years), with equal racial representation: white (43%), black (25%), and Hispanics (20%). The majority had good baseline functioning, only 7% of patients having a pre-event psychiatric diagnosis, moderate grade (median 3 (IQR 1–4)) on the CCI, 71% were in-hospital arrests, 47% presented with shockable rhythms, median ROSC was 8.5 min (IQR 3–15), and 35% were eligible for TTM with 92% cooled to 32–34°. Median length of ICU and hospital stay was 9 (IQR 5–18) and 22 (10–36) days, respectively.

38% (n = 30) of patients were women. No significant gender specific differences were found for age, race, CCI scores, premorbid CPC or psychiatric diagnoses, arrest related variables, rates of TTM administration, or length of intensive care unit or hospital stays (Table 1).

Outcomes

Women were found to have significantly worse RBANS scores for total, visuospatial, language, and attention domains. Women were also found to have significantly worse M-PSMS and CES-D scores (Table 2). These significant gender specific differences were maintained for RBANS, M-PSMS, and CES-D scores, in both uni- and multivariate models, after adjusting for age, initial rhythm, time to ROSC, and TTM administration (Table 3). There were no significant gender specific